

# SCIENCE

FRIDAY, FEBRUARY 1, 1889.

## OIL-BURNING STEAM-ENGINES.

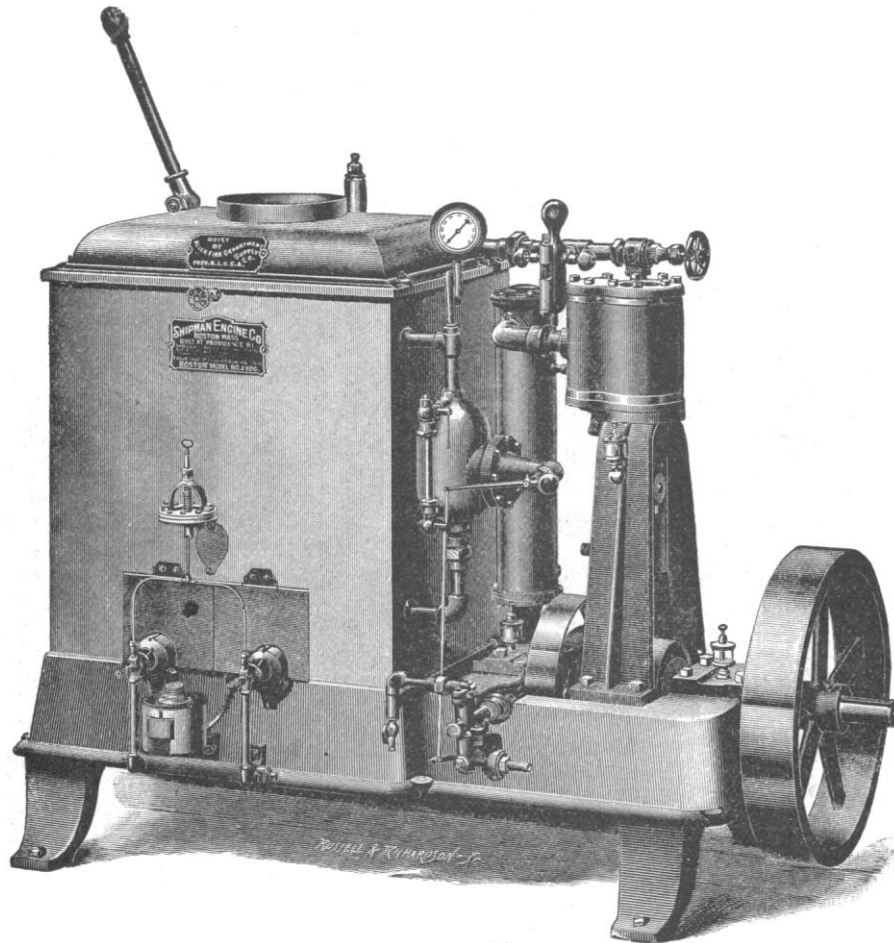
THE engine known as "The Shipman," an illustration of which accompanies this article, is an automatic steam-engine and boiler complete, using kerosene-oil of a low test for fuel, and is designed for all users of a moderate amount of power. Its essential points are, that it is so thoroughly automatic in fuel, water-supply, and speed, that, when steam has been raised, little if any further atten-

tion is required beyond that of opening or closing the throttle-valve when the engine is started or stopped. In burning the oil, no wicks are used, and there is nothing to gum up or clog. The fire is formed by a mixture in proper proportions of steam and oil. This is fed through one or more atomizers, according to the size of the boiler. A supply of steam from the boiler passing through these atomizers carries with it into the fire-box, in a fine spray, just the amount of oil necessary to generate steam for the work being done by the engine. As the oil enters the fire-box, it is ignited by a torch, and the combustion is so perfect that there is little or no smoke; so the full value of the heating qualities of the oil is obtained.

The amount of steam and oil used by the atomizers is controlled by a perfectly automatic diaphragm-valve, located in the steam-pipe between them and the boiler. Through this diaphragm, the mechanism of which is simple, and to which easy access can

be had, passes the steam on its way to the atomizers; and, as the pressure of the steam in it becomes greater or less than the tension of the spring which governs it, a valve attached to the diaphragm-plate is made to close or open, and thus regulates not only the amount of steam and oil being consumed, but also the pressure in the boiler. In this manner the fire is increased or decreased, according to the load on the engine, and the steam-pressure is kept constant. The height of the pressure to be carried is at the option of the user, and can be varied by him almost instantly.

If the engine is stopped, the fire is entirely put out by the diaphragm; but upon starting again, the fire at once relights itself, the



FOUR-HORSE-POWER SHIPMAN ENGINE.

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If the engine is stopped, the fire is entirely put out by the diaphragm; but upon starting again, the fire at once relights itself, the steam-pressure having been held, in the mean time, by the automatic action of the diaphragm, which will have allowed just enough oil to be burned to make up for the loss of steam by condensation. The supply of oil is stored in a tank placed at any convenient distance from the boiler, and is led to it by ordinary piping. The boiler consists of a hollow oblong back constructed of steel and thoroughly stay-bolted. Into one side of this back are screwed lap-welded wrought-iron tubes one and three-quarters inches in diameter, and thirteen inches in length. These tubes are closed at the outer end by a welded plug. This makes a very compact and quick-steaming boiler, gives large heating surface, and insures safety, it being almost impossible to explode one so that it will do harm. The boilers are tested by a hydraulic pressure of four hundred pounds. As a matter of record, steam can be raised on a four-horse-power boiler, from cold water to one hundred pounds pressure, in ten or twelve minutes.

The water-supply is by a plunger feed-pump, run direct from the engine-shaft, and is kept at a uniform level in the boiler by means of a float connected to a valve in the suction of pump. This float is in a chamber which is connected by piping to the top and bottom of the boiler, and rises or falls with the water. The movement is conveyed by levers to the valve in the pump, which it opens or closes as the water-level changes.

The engine is well built, and of the best material. The piston is solid, and has sectional packing-rings, each section overlapping the other, and being set out by independent springs. This, of course, makes a very tight and true-wearing ring.

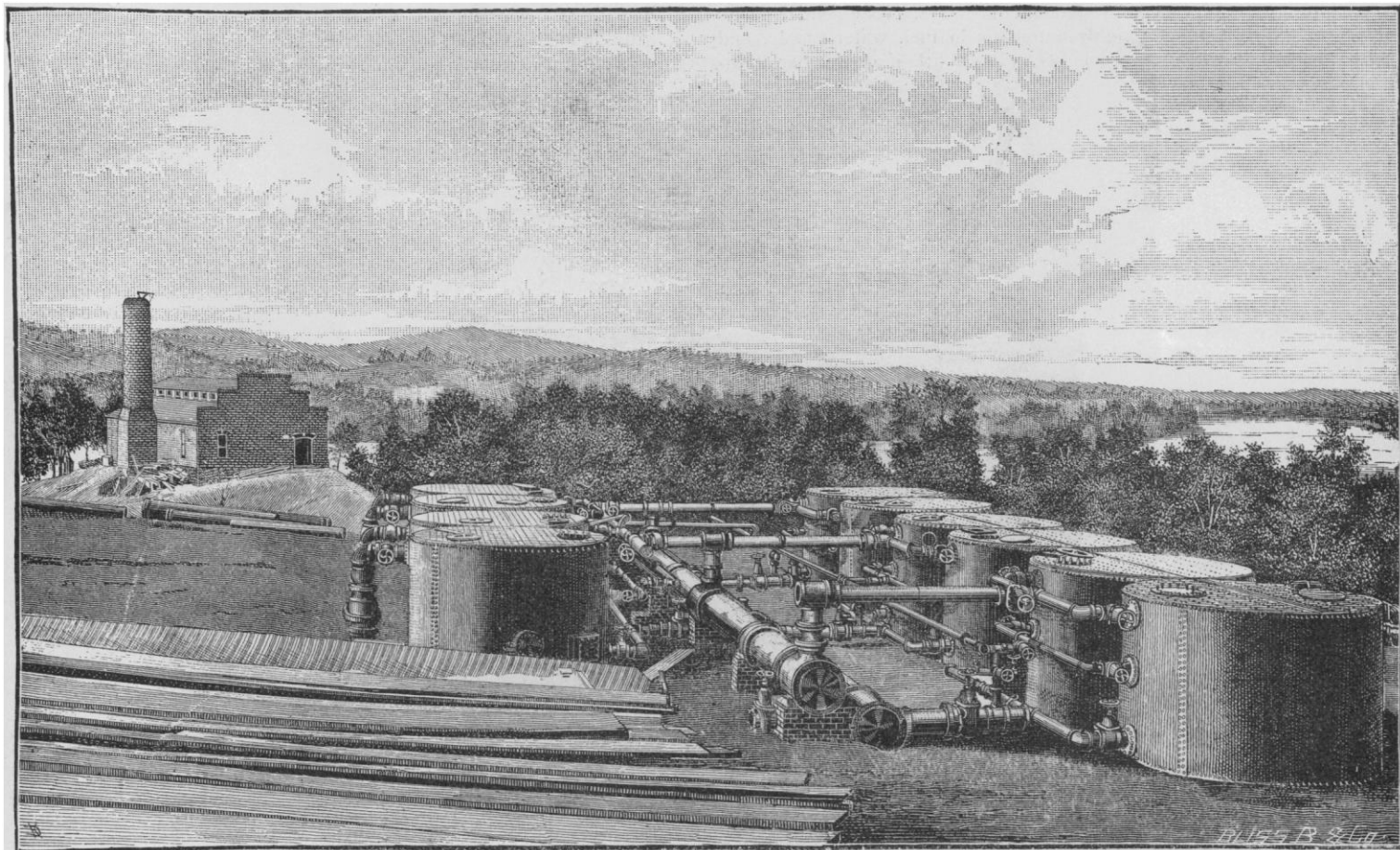
The valve is of the piston type, and perfectly balanced.

The governor is an automatic cut-off, working direct from the shaft to the valve; and the speed is very finely regulated, no matter

The engines and boilers are now built on one or separate bases, of one, two, four, six, and eight horse-power, and the company have in process of construction compound and triple expansion engines of various sizes. For further information, address the Shipman Engine Company, 92 Pearl Street, Boston, Mass.

#### WATER FILTRATION AND AERATION.

THE rapid growth of the mill industries, and of the arts and manufactures in general throughout the country, bring more than ever prominently to the front the important questions of the purity of the water-supply, and the necessity of taking immediate and active measures to secure this greatly to be desired quality. Particularly is this the case in the southern section of the country, toward



NATIONAL FILTER PLANT AT CHATTANOOGA, TENN.

what the load. The shaft is of cast steel, very large, and having extra long bearings in babbitted boxes.

All wearing parts are of extra size, and adjusted for the taking-up of lost motion. Lubrication of the cylinder is by a sight-feed; and the slides and shaft-boxes, by the ordinary oil-cup. Oiling of the crank-pin is effected by a centrifugal oiler attached to the crank-disk.

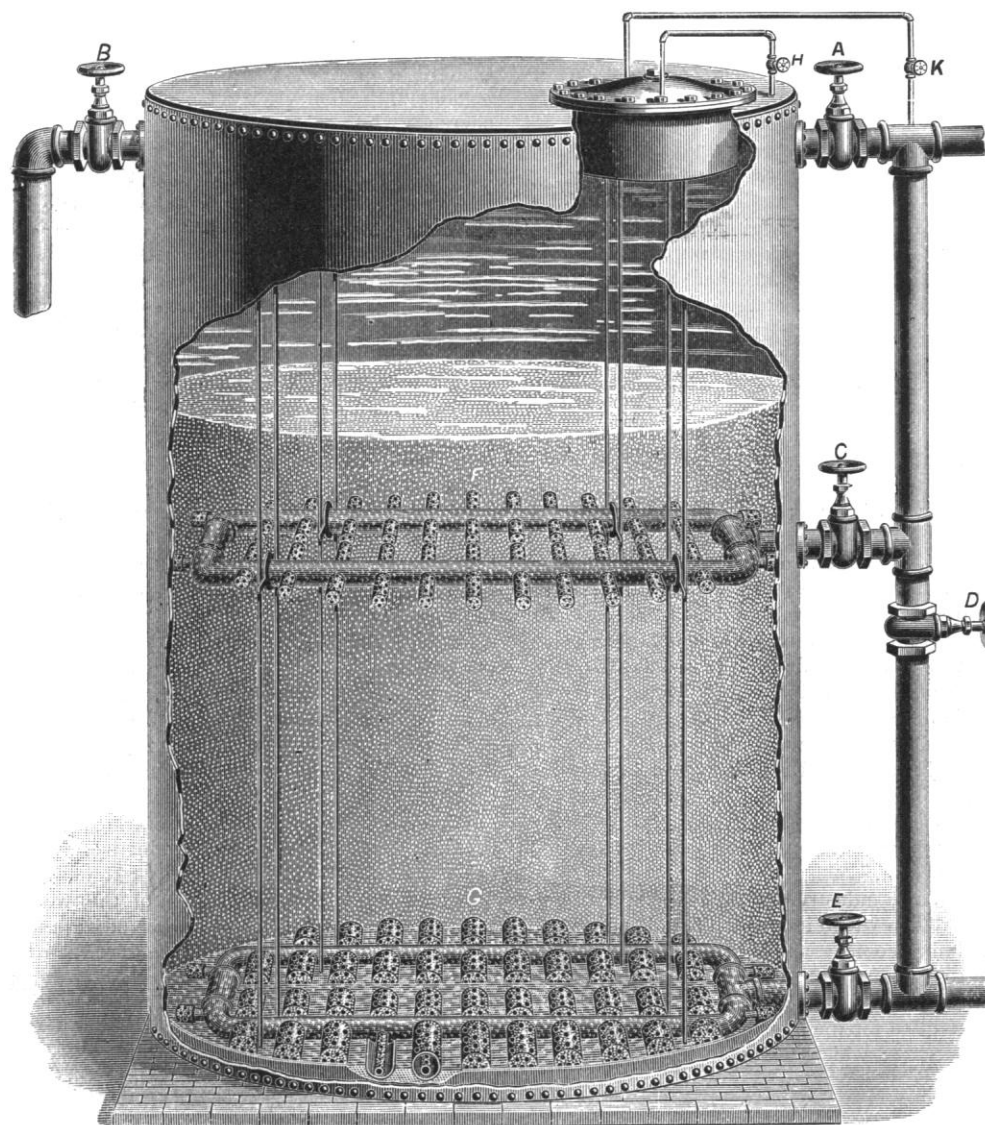
From the above it can be seen that when steam has been raised, and a sufficient quantity of oil and water supplied, the engine requires no further attention.

The question is asked, How are the fires operated when there is only cold water in the boiler? For this purpose a hand air-pump, attached to the boiler, is provided. A few strokes of this pump will start the fires, and it is only necessary to pump slowly for seven or eight minutes to raise enough steam to keep them going. As soon as steam is made, all work with the air-pump ceases, and, as before stated, one hundred pounds can be raised in from ten to twelve minutes. As regards the other advantages of "The Shipman," it can be said that it is compact, light, and durable, and entirely dispenses with the services of a skilled engineer.

which the attention of capitalists throughout the world is being more and more attracted. The more important features of health and cleanliness render it an imperative duty to prepare for the rapidly increasing population of our cities by taking judicious measures to secure to every community that system which, having simplicity and durability to recommend it, will, while being economical, insure a sufficient supply of pure water for individual use as well as for the factories and mills. Our country is blessed with a plentiful water-supply in almost every section, and the very fact of the abundance of this supply necessitates the precautions above referred to; as so large an amount of matter is carried in suspension in most of our large rivers, that some system of filtration must be resorted to. Some of the features that tend toward the perfecting of apparatus for this purpose are the ability to maintain the necessary "head or pressure," simplicity of construction, durability, quickness and thoroughness in cleansing, economy in water to accomplish this cleansing, cheapness, strength to withstand any desired pressure, and capacity to supply the maximum amount of clear water required for the purpose in view. The National Water

Purifying Company of New York have in their apparatus combined many, if not all, of these requirements; and an extensive plant installed by them at Chattanooga, Tenn., gives conclusive proof that scientific principles have entered into the construction of the plant, which seems to have well stood the crucial test of actual practice. The rapidity and thoroughness with which these filters can be cleaned, and the small expenditure of water required, are qualities in which this company excels, as they seem to have effectually solved the vexed question of surface washing. It has been found, from long experience, that most of the impurities taken from water, in the course of twenty-four hours lodge in the upper

in the boiler, necessitates a periodical stopping for its removal, ceases to be troublesome. It has been demonstrated beyond question that the thorough purification of drinking-water can be accomplished by combining aeration, precipitation, and filtration; and it is also reasonably claimed that the thorough aeration of water under pressure has the effect of destroying bacteria and plant-life that would be injurious to health. The aeration is accomplished by means of an air-compressor, whereby air is forced into the water under high pressure, thus producing a chemical action, which destroys the disease germs in the water, making it clear and sparkling. The process employed to attain this end by



SECTIONAL VIEW OF NATIONAL FILTER (250 GALLONS PER MINUTE).

six to ten inches of the sand-bed through which the water must pass before it leaves the filters, and that in their large machines, having a capacity of 250 gallons per minute of pure filtered water, this surface washing can be accomplished in four minutes, after which a reverse current up through the sand-bed breaks it up completely, and throws out all the finer particles of dirt. As the only labor required to accomplish this cleansing is the mere opening and closing of valves, the reverse current doing all the work, some idea of the extreme simplicity of the filter can be formed. By creating a feed of water free from those impurities which induce the formation of "scale" in boilers, a great economy of "fuel" is effected; the salts and other deleterious substances being deposited in the sand-bed of the filter, instead of passing into the boiler and shortening its period of usefulness by hastening corrosion; while the sediment that induces foaming, and which, gradually settling

the National Water Purifying Company is simple and inexpensive, and by it the amount of air forced into the water can be regulated to the exact requirements of the case. As a result, all odor in the mains, and vegetable growth, such as algæ, in the reservoirs, are prevented.

#### THE CULTIVATION AND UTILIZATION OF RAMIE IN THE UNITED STATES OF AMERICA.

IN his recent report on the Brussels Exhibition, Mr. Joseph Zervas draws attention to the importance of the cultivation of ramie. During the last thirty years, he says, numerous experiments have been made with a view to finding new plants yielding textile fibres. One of the most promising among these is the ramie, which is obtained from two plants, — *Bohmeria nivea*, yield-

ng white ramie; and *Bohmeria utilis s. tenacissima*, yielding green ramie. The fibre, which is also called "rhea" and "China grass," has been imported in considerable quantities into Europe, and extensive experiments have been carried on in regard to its utility.

Ramie is a perennial plant, the bark of which gives a textile fibre superior in tenacity and resistance to that of flax and hemp, while at the same time its length, fineness, clear white tint, and lustrous brilliancy, give it a great resemblance to silk. The amount of textile material obtained from a certain quantity of this plant is considerably larger than that obtained from an equal quantity of either flax or hemp.

Although in some respects inferior to silk, it can be used as an imitation of it; while it will undoubtedly supersede hemp, flax, and harl. Like cotton, it will have its centres of manufacture, and the peoples of the earth will be interested in the progress made in its use. The beauty of its products, the fineness and durability of tissue, more especially its clear tint, make it suitable to take the place of linen goods; and its easy manufacture will insure its rapidly gaining supremacy over other textile products.

The cultivation of ramie was introduced into Mexico by Mr. Benito Roelz de Santo Comspan; into the United States, by Mr. J. Bruckner of New Orleans; and into Belgium, by the Josephites of Melle, near Ghent. In Germany and Bohemia the first experiments were made with white ramie, as it was thought to be more advantageous, owing to its readier acclimatization to countries less warm than China or Japan, from which it had before been imported; but so far its cultivation, for reasons which will be shown later, has made but little progress. Recently machinery has been invented which makes its manufacture more successful; and since that time this industry has made rapid progress. Governments of several European nations are taking an active interest in the cultivation of this plant.

The utilization of ramie fibres is of great antiquity. Their virtues are recorded in the poems of Ramagana and of Kalidasa, who sing the praises of the stuffs made from ramie, which seems to have been grown at that time in the Himalaya Mountains. Pallas contends that the Chinese frequently deceived the Russians by selling them stuffs manufactured from ramie-thread (the wool alone being of real silk) as real Damask silk. We find in the annals of Nestor, of the year 904, that the sails of the Volga vessels were nearly all manufactured from ramie fibre.

Various kinds of nettles, or ramie, were cultivated in Russia, Siberia, Kamtchatka, and Japan. Dr. Boyle says that in 1810 the first tests of Sumatra ramie were made in India. In 1851 experiments were made in the spinneries of Leeds, which proved very encouraging. In 1868 the price of the raw fibre was £20 per ton at Calcutta, and £40 at London.

Although the cultivation and industry of ramie are still principally limited to the countries to which its growth is indigenous, the attention of every agricultural country, and of every textile manufacturer, should be drawn to its value with a view of determining as to the benefits to be derived from its introduction.

No country is better adapted for the introduction and cultivation of ramie than the United States, which, owing to its extensive territory, affords all possible conditions for cultivation as regards either soil or climate, and where the power of capital conduces so favorably to the development of enterprises.

It is not difficult to imagine the importance which this new industry may gain in the United States, when we consider that in 1887 the total importation of textile material (flax, hemp, jute, and other vegetable substances) from foreign countries into the United States amounted to about one hundred and twenty-three thousand tons, representing a money value of fourteen million dollars.

The exportation of vegetable fibres of every kind to the United States from the consular district of Brussels (Belgium) amounted, in 1880, to \$54,411.88; in 1881, \$58,307.68; in 1882, \$34,065.78; in 1883, \$41,989.20; in 1884, \$37,041.14; in 1885, \$51,004.56; in 1886, \$62,587.30; in 1887, \$39,245.92. The falling-off in the exportation of last year is due to the probable change in the tariff.

It has been inferred above, that, as a result of experiments made towards acclimatizing ramie in foreign countries, there has not been any extraordinary industrial success, although remarkable progress regarding our knowledge of the plant, and the best methods of

treating it, has been made. Even in the utilization of the fibre for spinning purposes, many difficulties were encountered until lately. The obstacles in the way of the cultivation of ramie arose principally from the fact that the plant itself, and the practical utility of it, were unknown; that statements regarding its use had been found erroneous, exaggerated, and untrustworthy.

No knowledge whatever of the soil suitable for its growth and cultivation, nor of the proper climate, was possessed. The culture of an inferior kind of ramie was introduced into northern countries, and its merits were so highly exaggerated that its partial failure prejudiced many of its warmest adherents. This species, the white ramie, is not nearly as good as the green.

Among the different kinds of ramie experimented upon with a view to their introduction into Europe and America, only these two species are accepted as being useful and suitable for acclimatization. The *Bohmeria nivea* (the white ramie), of Chinese origin, belongs to the temperate zone. The under part of its leaves is of a nacreous white color, with green veins, the leaves and stalks being very vigorous. The ripe stalk is of a red-brown blood color. Its fibre is greatly inferior to that of the green ramie, it is rougher to the touch, is not so full, and bears less resistance to tension. The stalks do not grow so high, and they have less tendency to run to seed. The plant also resists the cold better; for, while one has to be protected in severe weather, the other has not, and can be left in winter in a meagre soil. The *Bohmeria tenacissima* (green ramie) comes originally from an equatorial district, Java. Its fibres are very strong, and the plant is more hardy, and more prolific in fibrous textile, than the other.

The average height of the stalk of the green ramie is about five feet and a half to six feet, while that of the white ramie is of considerably less height, being about four feet and a half. In addition to this, the latter plant grows numerous side branches, which renders pruning more difficult. Accordingly, the product of the green ramie is shown to be superior to that of the white ramie.

It would seem, therefore, that it is a mere question of climate, which favors white ramie, though a recent cultivation of green ramie in Italy, in the province of Padua, shows it to have withstood a temperature of  $-9^{\circ}$  C. or  $16^{\circ}$  F. In Algeria green ramie has been cultivated exclusively for some time.

Ramie can be raised from seed, from suckers, or from layers or pieces of roots. That reproduced by seed-plots requires too much care, and has a greater tendency to run wild. Suckers have various disadvantages: ten per cent die, and the others cannot withstand the cold. The simplest, surest, and most productive mode of reproduction is by pieces of roots, or cuttings of stalks stuck into the ground. This kind is more productive, fuller, is neater and more easily grown, and reaches maturity at an earlier period.

A comparison of the cultivation of the two species in Italy gives the following result as a fair sample of its produce. Ten thousand mother plants on one hectare gave for two cuttings, —

|                  | Dry Stalks,<br>Kilograms. | Pruned Fi-<br>brous Textile,<br>Kilograms. | Harl per 1,000<br>Kilograms<br>Stalks. | Harl.<br>Per Cent. |
|------------------|---------------------------|--------------------------------------------|----------------------------------------|--------------------|
| White ramie..... | 6,000                     | 1,030                                      | 172                                    | 17                 |
| Green ramie..... | 8,000                     | 1,600                                      | 199                                    | 20                 |

The soil in which ramie should be planted should be light, sandy, well manured and cultured, naturally cool and moist. A good underground is indispensable, as the plant throws out its roots to a depth of from twelve to fourteen inches. It may be said, however, that it accommodates itself readily to almost any kind of soil, but the one indicated gives far superior results. If the soil be too rich, the plant thereby acquires a deleterious amount of ligneous material, which lessens the strength of the plant's fibres. The stalk becomes sappy, more difficult to prune, and hence inferior in quality. A too damp or marshy soil is injurious; although it has been experienced in different districts where it is grown, that a thick coat of mud of a sandy nature, the result of an inundation, has proved rather favorable instead of prejudicial in its effect. A



persistent drought gives a thin and sickly crop: therefore it will be found necessary, where the plant is grown under the influence of great heat, to facilitate the vegetation by frequent irrigations, according as the soil is more or less of an absorbing nature. At least two weeks previous to the cutting of the plant, the irrigations ought to be discontinued, to allow the stalks to gather sufficient strength, ripen, and dry sufficiently for use. In order to secure a good crop, and avoid fermentation of the stalk, it is preferable to cut in dry weather. The manner of planting is quite simple. In the soil already prepared, furrows at least three feet apart should be ploughed (similar to those made in planting potatoes). The plants are then placed in the furrows at three inches depth, so that they alternate with those of the next line. Each plant requires a square yard for its development. This space will be occupied by direct shoots or rhizomas from the end of the second year.

In the third year it will be necessary to thin the plants. In order to secure a free circulation of air, the soil should be carefully weeded during the first year of the plant's growth. In the second year it will be found unnecessary, the ramie overgrowing the weed. It is advisable in spring, or after the first cutting, to dig up a little of the soil about the roots. As the plant is perennial, the better the soil is prepared, the better will be the results. Quoting from the analysis of Dr. J. E. Tornidge, the composition of the fibre is as follows:—

|                          |        |
|--------------------------|--------|
| Potash .....             | 32.37  |
| Soda.....                | 16.33  |
| Lime.....                | 8.50   |
| Magnesia.....            | 5.39   |
| Oxide of iron .....      | .17    |
| Chloride of iodine.....  | 9.13   |
| Phosphorus.....          | 9.60   |
| Sulphur.....             | 3.11   |
| Carbon.....              | 8.90   |
| Alumina and silica ..... | 6.60   |
| <hr/>                    |        |
|                          | 100.00 |

Ramie, like flax and hemp, exhausts the resources of the soil rapidly: therefore careful manuring is necessary. The above analysis may be a guide in selecting the fertilizer. In Europe only two cuttings a year can be depended upon; for, even by the use of liquid manure with irrigation, it has been ascertained that a third crop is extremely sickly and weak, even under the most favorable circumstances. In countries where the climate resembles that of regions to which the plant is indigenous, as many as five crops can be obtained if great care be given to its cultivation. The best time for gathering it is when a red-brown color is visible in the lower part of the stalk.

The stalks should be cut at about four inches from the ground, by a clean incision, to avoid damage. It is then necessary to dry them quickly in the sun; and they should be peeled within at least forty-eight hours, after which time peeling would be difficult.

If stored for winter use, it should be kept in a dry place. In the process of drying, the leaves should be stripped. If used for cattle-forage, as is often the case, they should be given while still green. This, however, is an expensive proceeding. When the stalks are dried with the leaves remaining on them, they can be easily shaken off at the end of two days. They can be usefully employed in the manufacture of paper, or left on the ground, for which they form a good manure. The produce of the stalk is, as shown, dependent upon the climate and proper treatment. As no statistics have yet been made in countries where its growth is indigenous, it is necessary to make an estimate from the results obtained in countries less favorable to its growth: therefore the estimates are probably too low. In Italy, in the third year, when the plantation reached its definitive state, the produce of one hectare (2.471 acres) of ramie amounted to about 80,000 kilograms (1 kilogram = 2.2 pounds) green stalks, of which one-half is attributable to leaves. The first cutting gave 41,200 kilograms, the second 39,700 kilograms, green stalks, which together makes 80,900 kilograms. Deducting fifty per cent leaves, there remain 40,450 kilograms of green stalks, or 1,600 kilograms harl. Two thousand kilograms of harl have even been obtained, and 1,800 is not an exaggerated average, per hectare.

Labor, manure, rent, pruning-machines, and general expenses are of course to be counted; and, as such expenses would in

America be highly in excess of those in Italy, it could only be by practical trial and experiment that the cost of its cultivation in the United States could be ascertained. The results show, however, that the cultivation is extremely remunerative, and in the United States it would prove still more profitable.

The greatest difficulty yet experienced in the industry is that of properly peeling or decorticating the stalks. With a view of promoting this industry, the Indian Government, in 1870, offered a prize of £4,000 for the best machine manufactured to peel the raw fibre; subsequently a prize of £5,000 was offered in England for the same purpose; and quite recently an exhibition has been decided upon, to be opened on the 25th of September, by the minister of agriculture in Paris, for machines for the purpose of peeling ramie stalks. As in the case of all textile plants, the object is to separate the ligneous part from the herbaceous part; that is to say, the stalks from the bark. The ligneous part is used for manure only. The bark, on the contrary, contains the fibrous matter for the manufacture of harl. Its manufacture is possible in several ways. First, during the first two days after the cutting of the stalk, the viscous liquor which is found between the ligneous part of the stalk and the bark allows it to be peeled with facility. The Chinese and Indians simply employ their forefinger and thumb to peel the bark while in that state. This is of course primitive, and machines based on that principle have always been found unsatisfactory. Second, many inventors proceeded, as in the case of flax and hemp, by a kind of previous maceration called "retting;" but this also has proved unsatisfactory, on account of its speedy putrefaction, hemp being capable of greater saturation than ramie. Third, chemical operation has at all times proved prejudicial to ramie fibre, causing loss of weight and brilliancy of appearance. Fourth, other manufacturers constructed machines with a view to abandoning retting. These are constructed so as to peel the harl, and do the least possible injury to the textile qualities of the plant, and, by working the plant when dried, to completely disaggregate the fibre so as to render it of greater value. When working green, there is apt to be a great loss of fibre, as it is impossible to perfectly peel the stalk. The disaggregation is poor, the fibre leaving the machine in strips, which necessitates its being worked by chemical substances, to obtain the division of the thread: hence a machine working dry, with little loss, is of greater advantage.

Among the machines working green, that of the American, Mr. Berthel, gives a waste of more than one-half of the textile fibres. Requiring a force of two horse-power, it is able to work 150 kilograms (330 pounds) of dry harl per day, the price being \$500 for this machine. The machine built by Felix Roland, a French engineer, is somewhat better; but the waste still amounts to two-fifths of the whole. The machine of three-quarter horse-power works 150 kilograms of dry harl, and costs \$250; that of one horse-power works 200 kilograms (440 pounds) dry harl, and costs \$360. The machine of Messrs. Moermann-Laubuhr, Belgian engineers, which is really an old flax machine, requires a previous maceration of the plant, necessitating thereby inconveniences. It requires four horse-power to work 200 kilograms of harl per day, and its price is \$1,200. Among dry-stalk working machines is one manufactured originally for flax by Arthog, which works 100 kilograms (220 pounds) at two horse-power, and its price is \$800. Until recently (1875), the best machine originally built for flax was manufactured by Cardow & Son, and improved upon by Huet Lagache, for the treating of ramie; but the harl often rolled up around the cylinder, the brown epidermis was often left, and considerable loss ensued. The produce is 200 kilograms for four horse-power, the price being \$2,000. Felix Roland, who was mentioned above, also built a machine for working dry stalk. Little injury, as well as little loss, was experienced by the use of this machine. Of these machines he has three different sizes. No. 1 produces 60 to 70 kilograms (130 to 154 pounds) a day, worked by a man, the price being \$300; No. 2 produces 150 to 160 kilograms (330 to 352 pounds) a day, three-quarter horse-power, the price being \$440; No. 3 produces 200 to 250 kilograms (440 to 560 pounds) a day, one horse-power, price \$600.

Peeling expenses do not exceed three per cent by this system, wages being reckoned at \$1.25 per day. This machine was considered the best, as is shown by the fact of the minister of the

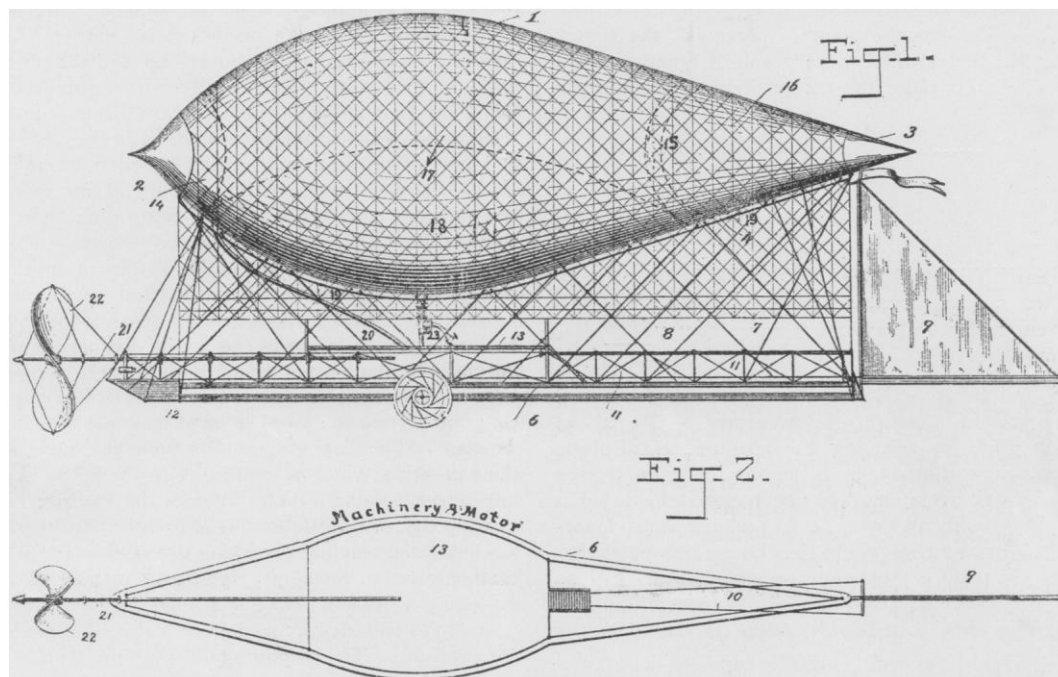
French Navy buying one for the colonies of Guinea, etc. Lately, however, in the Brussels Exhibition, the new stripping and peeling machine of Norbert de Landtsheer from Paris was exhibited, and it is the most simple, complete, and inexpensive machine yet used for the peeling of either dry or green stalks. Peeling is accomplished without crushing, and the threads are free from cuts. The disaggregation is perfect, and the machine is free from waste in either dry or green peelings. The daily product is: dry, 100 to 158 kilograms (220 to 330 pounds), a quarter to one horse-power; green, 100 to 200 kilograms (220 to 440 pounds), a quarter to one horse-power, price \$240. A machine run by hand-power produces 75 kilograms (165 pounds), price \$200.<sup>1</sup>

On a large scale of cultivation, a corresponding series of machines built by Norbert de Landtsheer will be necessary. With this in view, and the value of these machines being established, there is no longer any doubt as to the success of its introduction into the United States, where the conditions of soil and climate are so favorable.

they birds or fish, have such a form, the larger end being the forward end in their movements. To maintain the shape under varying pressure, there are two air-tight conically shaped compartments, — one at each end of the balloon proper, — into which air or other gas may be forced, as occasion may require, to keep them distended.

The buoyant power it is proposed to make just sufficient to raise the ship; and if, on rising higher, the warmth of the sunlight or other cause should expand the balloon, some of the gas would be removed, and condensed, thus doing away with the clumsy make-shift now in vogue of throwing out ballast.

To start with, the balloon is supposed to be filled with just enough coal-gas to cause it to rise. As the balloon rises, a portion of this gas may be withdrawn and compressed, and another portion may be employed to drive the motor, and some part will escape. To replace this loss of buoyancy, there is a reservoir in the car containing a solidified gas, the composition of which Mr. Boisset still keeps a secret, but the basis of which is ammonia, from which



THE AIR-SHIP OF LOUIS BOISSET.

1. Extremity of the inflated part; 2. Front cone; 3. Back cone; 4. Nets; 5. Riggings; 6. Lower parts of the car; 7, 8. Fringe of the net; 9. Rudder or guiding sail; 10. Passengers' cabin; 11. Safety-rail; 12. Front extremities of the car; 13. Machinery and motor-room; 14. Front air-tight compartment; 15. Back air-tight compartment; 16. Large back air-tight compartment; 17. Centre of gravity; 18. Large central compartments for ammoniacal gas; 19. Metallic bar (very light); 20. Gas-pipes for the motor; 21. Shaft of tractive screw; 22. Tractive screw; 23. Throttle-valve for ammoniacal gas; 24. Wheel with air-sails.

It is not within the scope, nor is it the intention, of this article, to advise agriculturists to proceed to develop this industry on the strength of the information and statements contained in this report, but rather to draw the attention of the United States to the feasibility of its introduction into the country.

#### AN AIR-SHIP.

MR. LOUIS BOISSET, a retired officer of the French army, is now in this country, perfecting an air-ship, an invention of his, and seeking the protection of the United States patent laws.

Mr. Boisset has had some experience in recent years with the air-ships experimented upon by the French war department, the more or less successful voyages of which over the suburbs of Paris were recorded in *Science* in 1884. One trouble with these older forms Mr. Boisset believes to have been due to their symmetrical form, and he seeks to make the equilibrium of his balloon when in motion more stable by giving it, as shown in the figure, an ovoidal form, following in this the dictum of Mr. Dupuis de Lome, — that in general, organisms destined for motion in water or air, be

<sup>1</sup> At aforesaid September Exhibition at Paris the decorticating machine of De Landtsheer was recognized to be the best.

a fresh supply of gas can at will be obtained, and introduced into the lower compartment (18) of the balloon.

Mr. Boisset believes that he has made improvements over any thing that has gone before, in the shape and rigging of the ship, in the gas-motor, and in the method of compensation by which the equilibrium of the ship may be maintained. Further, the dividing of the balloon into air-tight compartments is a novel feature, and allows of replacing the consumed coal-gas by the ammoniacal gas, whatever its composition may be, without mixing the two.

Mr. Boisset estimates that a vessel of his construction, capable of crossing the Atlantic, should have a gas-chamber (the balloon proper) 62 metres in length, and with a maximum diameter of 20.33 metres. The height from the top of the balloon to the flooring of the basket would measure 31 metres; and the length from the end of the propeller to the end of the rudder-sail, 82 metres. The weight of the ship, its provisions, crew of ten men, and passengers, the inventor would place at 6,000 kilograms.

AMONG the features of the issue of *Light, Heat, and Power* for Jan. 19, are four photographic plates, illustrating the recent gas-holder explosions at the works of the Citizens' Gaslight Company, Brooklyn, N.Y.

## ELECTRICAL NEWS.

Hertz's Researches on Electrical Oscillations.<sup>1</sup>

IN reading Faraday's "Experimental Researches on Electricity," one finds many experiments described in which that philosopher attempted to show that some relation must exist between natural phenomena which had been considered as having no connection with one another. He tried to prove that gravitation could produce magnetic or electrical effects; and although he failed, yet at

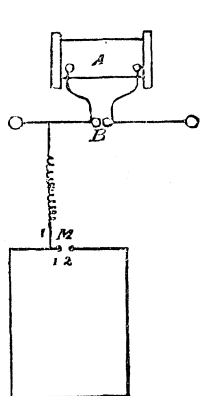


FIG. 1.

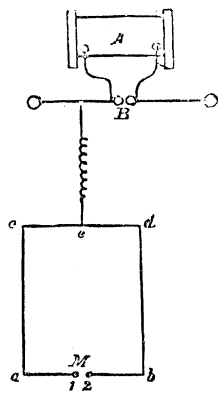


FIG. 2.

the end of the research he expressed his belief that some connection existed, and would some day be discovered. But he did find that a magnetic field had an effect upon polarized light passing through it, and this discovery has been developed until Maxwell advanced the hypothesis that electrical vibrations may be propagated through space according to the same laws that govern the propagation of light, and with the same velocity; and now the theory of Maxwell has been experimentally verified by Hertz. The evidence in favor of Maxwell's theory, before Hertz published his work, lay principally in the facts that the equations of propagation of an electro-magnetic disturbance were practically those which have been deduced for light, and which have explained a number of the phenomena that take place. The velocity of such a disturbance is equal to a constant which can be determined electrically, and which agrees very well with the observed velocity of light; while a relation between the specific inductive capacity, determined electrically, and the index of refraction of a substance, agrees fairly well with that deduced from Maxwell's theory. Hertz has added to this evidence a proof—indirect, but fairly conclusive—that the "electrical displacements" in a dielectric, on which rests much of Maxwell's theory, really exist; that actual electro-magnetic waves are reflected and interfere with one another; and that the velocity of such waves is about what is calculated. We will describe Hertz's experiments as clearly and briefly as possible, referring those who desire a detailed description to Hertz's and De Funzelmann's papers.

In the first place, it was necessary to produce electrical oscillations of a very small period. Roughly, the period of a light-wave is  $10^{-15}$  of a second, and we know of no way of producing electrical oscillations, on a conductor of finite size, of any thing near so rapid a period. When Hertz took the matter up, the most rapid oscillations that had been experimented upon were those caused by the discharge of a Leyden jar through a resistance, the period being about  $10^{-6}$  of a second. Theoretically a much shorter period would be obtained with conducting-wires forming an open circuit, the ends having small knobs on them; and this is the form Hertz first experimented on, his object being to discover whether measurable oscillations were really produced. The period in this case should be some hundred millionths of a second, —  $10^{-8}$  as compared with  $10^{-15}$  for light. The general arrangement of the apparatus is shown in Fig. 1. Here *A* is a large induction-coil, with the wires *B* fastened to the terminals of the secondary circuit. The

coil Hertz used was a large one, 52 centimetres long by 20 centimetres in diameter, and it was run by six large Bunsen cells.

When the coil is working, there are sparks between the knobs *B*; and, when one of these sparks passes, we have the case of the discharge of conducting-wires forming an open circuit; and this will cause rapid oscillations along the wires, which will diminish in amplitude until they are re-enforced by another discharge. To observe these disturbances, Hertz arranged a circuit, shown in Fig. 1 at *M*. This was simply an open circuit of wire, with two adjustable knobs, 1 and 2. On connecting this "micrometer" circuit to one of the wires *B*, the connection being as shown in Fig. 1, sparks, sometimes several millimetres long, passed between 1 and 2.

The reason of this is, that the rapid and violent oscillations on *B* are transmitted to the knob 1, sometimes causing a high and sometimes a low potential at that point. Now, if it takes a finite time for this disturbance to travel around the circuit *M*, then there will be for a short time a considerable difference of potential between 1 and 2, and this causes the spark. With the connection to *M* made as in Fig. 2, the distances of *e* from 1 and 2 being equal, then the disturbance reaches these points at the same moment, and there is no difference of potential between them, and therefore no spark. This is what Hertz actually finds.

Some of the facts that Hertz obtained were these: In the first place, the effect in the micrometer circuit depends on the shape of the terminals *B* and on the nature of the spark: the material and size of the wire of the micrometer circuit has very little influence on the spark. If, when the contact is at *e* (Fig. 2), a conductor be joined to one of the knobs 1 or 2, then the spark reappears.

This last, Hertz thinks, shows that the phenomenon cannot be due to single waves in the directions *ca* and *db* respectively, but must be due to a series of oscillations set up in the micrometer circuit; and the addition of a conductor to one of the knobs changes the period of vibration of that branch, the periods being determined by the product of the coefficients of self-induction into the capacities of the branches. The fact that the material of which the circuit is made has no effect on the spark, tends to show the same thing; namely, that the phenomena in the micrometer circuit are dependent upon self-inductions and capacities, that is, upon time-constants.

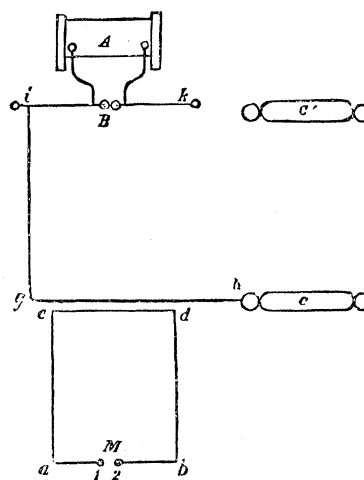


FIG. 3.

To further prove the oscillatory character of the discharge, Hertz used the arrangement of Fig. 3. Here the micrometer circuit was placed with one of its sides parallel to the wire *ig/h*, which was connected to one of the discharge wires *B*. The sparks at *M* were very feeble until a conductor, *C*, was attached to the free end, *h*, of the wire, when they increased to two millimetres. No effect was produced when *C* was attached at *g*. When the knobs at *B* were so far apart that no sparking took place, the sparks at *M* also disappeared, which showed that they were due to the sudden discharges, not to the charging current. While *C* was attached to *h*,

<sup>1</sup> Hertz's original papers are in Wiedemann's *Annalen*, 1888. Mr. G. W. de Funzelmann has given an excellent *résumé* of Hertz's work in the *London Electrician*, Nos. 539 545; 547, 548.

and the knobs at  $M$  drawn so far apart that the sparks only passed singly, then if a similar conductor,  $C'$ , be brought up to  $k$ , a stream of sparks was immediately observed. This action of  $C'$  could only be explained by supposing the current in  $g'h$  was oscillatory.

The reason that a powerful induction-coil gives rise to oscillatory motion is, that, first, it charges the terminals  $C$  and  $C'$  to a high potential; second, it produces a spark in the intervening circuit; and, third, as soon as the discharge begins, the resistance of the air-space is so much reduced as to allow of oscillatory motion being set up. If the terminal conductors are of very large capacity (for example, if the terminals are in connection with a battery), the current of discharge may indefinitely reduce the resistance of the air-space; but, when the terminal conductors are of small capacity, this must be done by a separate discharge, and therefore, under the conditions of Hertz's experiments, an induction-coil was absolutely essential for the production of oscillations.

Hertz slightly modified the form of apparatus used to that shown in Fig. 4, where the conductors  $C$  and  $C'$  were in the same straight line, three metres apart, with the discharger  $B$  at the centre. With this arrangement, sparks were obtained in the micrometer circuit when its distance from  $CBC'$  was one and a half metres. Hertz replaced the micrometer circuit shown in Fig. 4 by another, which

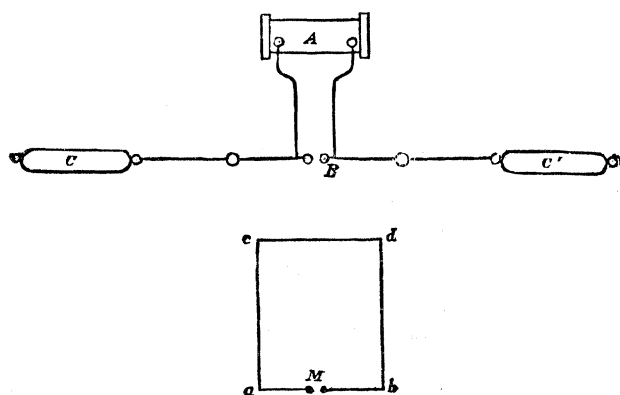


FIG. 4.

consisted of two wires parallel with  $CBC'$ , with knobs at their ends, there being a micrometer,  $M$ , at the middle. Sparks were obtained at the micrometer, as with the other form of circuit. When the knobs at  $B$  were drawn so far apart that there was no spark between them, there was still a spark at  $M$  due to the electrostatic effect of charging  $C$  and  $C'$ . By bridging across  $M$  with a damp thread, this effect was got rid of; but, when there were sparks at  $B$ , there were sparks at  $M$ , even with the thread. So the thread was sufficient to afford a passage to the comparatively slow alternations of the coil-discharge, but was not sufficient to provide a passage for the immeasurably more rapid alternations of the oscillatory current.

If there really are oscillations of the nature of a regular vibration, then an oscillatory current of a definite period would exert a much greater inductive effect upon one of equal period than upon one differing from it; that is, we ought to get resonance phenomena from currents, as from sound-vibrations. If two circuits are taken having as nearly as possible equal periods of vibration, the effect of one on the other will be diminished by altering either the capacity or coefficient of self-induction of one of them, as a change in either of these would alter the period of vibration of the circuit.

(To be continued.)

ANOTHER ELECTRIC ROAD AT ATLANTIC CITY, N.J.—We take great pleasure in announcing in this issue of our paper a most important indorsement of the electric system of street-railway propulsion. This indorsement comes from the Pennsylvania Railway Company, who have during this last week, through the general managers of that company, closed a most important contract with the Sprague Electric Railway and Motor Company for the complete equipment of their system of electric street-railways at Atlantic

City, N.J. Before awarding this contract for the equipment of this road, the Pennsylvania Railroad appointed a committee who should have charge of making a most minute and careful investigation of the merits of all the different systems of street-railway propulsion, both electric and cable, now in use. The committee in charge of the investigation were composed of mechanical and electrical experts of the highest class, and of wide reputation. The period of investigation extended over five months, and during this time the committee visited all the principal electric railways and cable roads which are in operation in this country, and carefully examined the operation of each. The Sprague Company are certainly to be congratulated upon securing this contract.

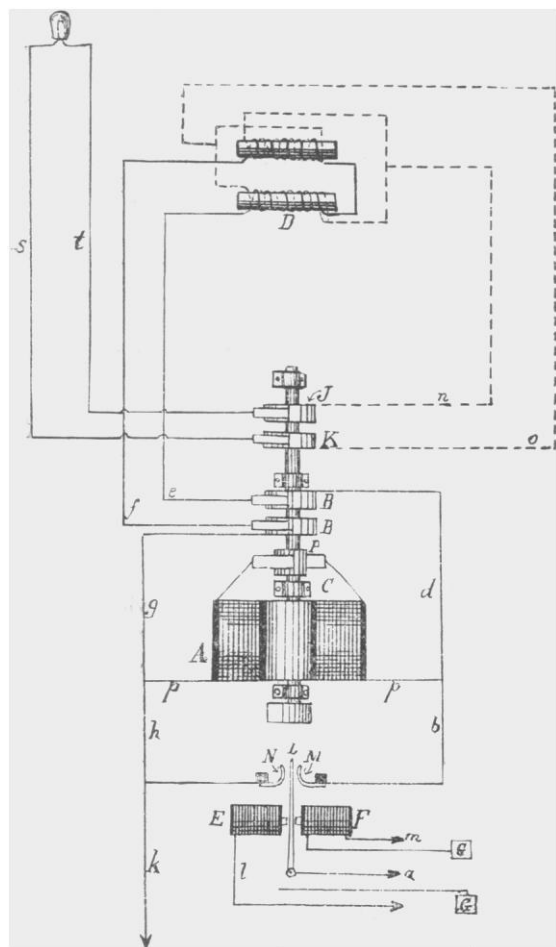
WEST END ELECTRIC ROAD AT BOSTON.—The West End Electric Railway at Boston is running very successfully, and carrying a large number of passengers each day between Park Square (one terminus of the road) and Brighton (the other terminus of the road). The cars run fast, and are under quick and perfect control. The residents in Brookline who use the cars regularly in coming into Boston and returning are enthusiastic over the time saved over the ordinary horse-car. The change of the overhead to the underground system is made very quickly, and without stop, so that no delay is experienced at this point. The car-drivers, or "motorneers," as some Bostonians persist in calling them, are not expert electricians, but simply street-car drivers, who have been detailed to operate the electric cars, and who have learned their necessary duties very quickly. All of these old drivers are enthusiastic over the ease with which an electric car can be driven, and are well pleased with their new position. On the 20th of January a very heavy snow-storm reached the city, and covered the tracks of the railway to the depth of from two inches to a foot. The electric snow-ploughs, which are being equipped by the Sprague Company for use by the West End Road, had not been finished, and the cars were obliged to run without this aid for clearing the tracks. In spite of this, the cars ran very successfully over the entire distance of the roads, clearing their own way, and carrying large numbers of passengers. The president of the road and the directors expressed themselves as well pleased with the demonstrated efficiency and strength of the electric road, as exhibited during the snow-storm, even without the aid of the regular Sprague electric snow-ploughs. The *Boston Herald*, in an editorial of Jan. 17, in commenting on the road, said, "Those who have made the experiment of taking a ride on the new electric railway on Beacon Street must have come to the conclusion that this method of securing rapid transit in the suburban wards is one of the most promising that has yet been brought forward in this city. The speed attained, where the conditions are favorable, is quite equal to that of the elevated railroads in New York City, while the structures supporting the electric wires are by no means as much of a disfigurement as it was at one time supposed that they might be." So long as a mixed service is maintained,—that is, so long as some of the cars are drawn by horses,—the full advantage of the electric system cannot be realized. The speed of the electric car has to conform to the speed of the horse-car which may be in front of it; but, if the experiment proves as successful as there is now every reason to think that it may, the West End Company will before long feel compelled to substitute electric for animal power in the service of all of its lines. When that change is brought about, the speed that can be made, even in the centre of the city, will be very much accelerated over the average speed of to-day.

A SOUTHERN ELECTRIC RAILWAY STARTED.—During the past week the Asheville Electric Street Railway, which has been in course of construction for the last month under the Sprague Electric Railway and Motor Company of New York, was successfully put in operation. The first trial trip of the motor-cars was made on Jan. 21, in presence of the president, Mr. W. P. Penniman, jun.; superintendent, Mr. J. H. Barnard; and a number of prominent citizens,—Capt. T. W. Patton, Gen. Jonstone Jones, Dr. S. D. Pelham, and about sixty others; some being stockholders in the road, and others interested, directly or indirectly, in the success of the enterprise. The test proved a great success. The run was made over the entire distance of the line, about two miles, in less than eight minutes, carrying a large number of passengers. The citizens of Asheville are enthusiastic over the new electric line, and the direc-



tors of the road express themselves as very well pleased with the successful performance of the motor-cars.

**A NEW SYSTEM OF ELECTRICAL DISTRIBUTION.**—One of the problems which has claimed the attention of inventors in the past few years has been the conversion of high-tension to low-tension electric currents. The object is to distribute electric energy at a high potential, using comparatively small wires, and at the points of consumption to reduce the potential to that demanded by safety and the requirements of incandescent lighting. A large part of the cost of an incandescent electric plant is in the wires used for distribution; and the size of the wire required to distribute a given amount of energy varies inversely as the potential used. One of the most successful converter systems is that



THE DICKERSON SYSTEM OF ELECTRICAL DISTRIBUTION.

used by the Westinghouse Company, where alternating currents are employed, and the reduction is effected by transformers, — induction-coils working backward. But there are some disadvantages in the use of alternating currents, and many attempts have been made to invent a continuous-current converter, that will do for continuous what the transformer does for alternating currents. Storage-batteries would offer an ideal method of effecting this, but for their cost and depreciation. Several mechanical methods have been tried, among others a motor-generator arrangement, — a combined motor and dynamo, the former supplied from the high-potential circuit, the latter supplying current at a low potential to the local circuit. Other plans have been proposed in which the main circuit is interrupted and advantage is taken of its inductive effect on the secondary circuit. None of these systems, however, are in successful operation on a large scale. Mr. Edward N. Dickerson, jun., of this city, received last week (Jan. 22) a patent on an improvement in his method of converting high-tension into low-tension currents. Feb. 14, 1888, a patent was granted Mr. Dickerson for a method of converting a direct high-tension cur-

rent into an alternating low-tension current; and by his recent improvement he is able to obtain a continuous low-tension current, which is a considerable advantage if the resulting current is to be used for a motor or for electric plating. The accompanying figures will make it clear how this result is obtained. A high-tension current flows out upon the circuit *a*, and returns to the generator by the circuit *b*. By the switch *L* it passes through the motor *C*. On the shaft of this motor is arranged the double reversing-commutator *BB*, the sections of which are alternately connected with the circuit *d* and with the circuit *g*. The current upon the circuits *ef* is a high-tension reversing current, and operates the converter *D*, which converts the reversing high-tension current into a reversing low-tension current. This induced alternating current passes to the reversing-commutator *JK*, by which the reversing currents are rectified. It is of course essential that the two commutators shall move synchronously, and the commutator *JK* should be so adjusted on the shaft as to allow for the time required by the converter. The switch *EF* may be omitted; but by it it is possible to throw any house into circuit from the central office.

**THE WESTINGHOUSE AND UNITED STATES COMPANIES.**—An agreement is reported between these companies whereby their interests are united. The United States Company is one of the oldest electrical manufacturing companies, and has a large factory in Newark, N.J. The Westinghouse Company was already the lessee of the Consolidated and Sawyer-Man Electric Companies of New York, and the owner of the Waterhouse Electric Company of Hartford, Conn., and the Tesla Electric Light and Manufacturing Company of Rahway, N.J. The new combination has a manufacturing capacity of over 15,000 lamps a day, and the two companies own and control about 700 patents in every branch of electrical invention.

#### NOTES AND NEWS.

It is announced that a post-graduate department in electrical engineering will soon be established by the trustees of Columbia College, this city. A beginning will be made upon an economical scale, and the facilities will be increased in proportion to the patronage, which it is believed will increase rapidly, as New York is a city in or near which all or nearly all of the many applications of electrical science may be studied in practical operation. The course will be open to graduates of all scientific schools.

— An electrical exhibition will be held in the Chicago Exposition Building, in connection with the National Electric Light Association Convention on Feb. 19, 20, and 21. Many exhibitors have already secured space, the electric railway companies being especially forehanded in that respect. The exhibition, though not intended to be of long duration, promises to be interesting and important.

— The *Journal of the Society of Arts* reports the discovery of a new textile on the shores of the Caspian. This plant, called "kanaff" by the natives, grows in the summer, and attains a height of ten feet, with a diameter varying from two to three centimetres. By careful cultivation and technical manipulation, M. O. Blakenbourg, a chemist and engineer, who has made a special study of kanaff, has obtained an admirable textile matter. It is soft, elastic, and silky, gives a thread which is very tough, and can be chemically bleached without losing its value. The stuffs manufactured out of kanaff, and then bleached, can be successfully dyed in every shade of color, and would compete with any of the ordinary furnishing materials now in use. But it is particularly for making sacks, tarpaulin, ropes, etc., that this new textile, from its cheapness and its extraordinary resisting power, might defy all competition. Its specific weight is much less, but its resistance much greater, than those of hemp. Thus, a cord of 8.25 millimetres diameter, woven with the hand out of three threads of kanaff, requires a weight of 180 kilograms to break it. A cord half an inch thick, manufactured at Moscow, did not break till the weight of 625 kilograms was reached. When it is considered that Russia annually consumes more than one hundred and fifty millions of sacks, a third of which are imported, it may be easily seen that the appearance of this new textile on the Russian market is an event of no slight importance.

## SCIENCE:

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IT APPEARS that *Science* will have to widen the field of its activity in combating politics in the schools. New Jersey is suffering, apparently, as New York City is, but with this important difference: in New York the politicians are intrenched; in New Jersey they are seeking to gain possession. The situation is this. A year ago an inefficient State superintendent of public instruction was superseded, on the expiration of his term of office, by Col. Charles W. Fuller, a lawyer of high standing, and a man of force and character. In one year he has revolutionized the administration of the office. On every side evidences of new life and activity are to be seen. The best and most useful teachers' institutes in the history of the State were held last autumn, with excellent results. Manual training, compulsory education, increased salaries, and other important measures, have been aided by Col. Fuller's administration. It so happens, however, that Col. Fuller is a member of a certain political party, which is not the one in control of the legislature this winter. In this the politicians have found their opportunity, and, by arousing partisan passions, are straining every nerve to legislate Col. Fuller out of office. It is not believed that this disreputable scheme will succeed, for every manly and fair-minded legislator, of whatever party, will oppose carrying politics into the schools. If the press of New Jersey expose the character of the contemplated legislation, it will surely fail.

ON THE 26th instant the board of naval officers continued its experiments with Capt. Zalinski's gun, the firing of which was to determine the accuracy of the range of the projectiles, which must, according to the requirements, fall within a rectangle 50 by 150 feet. The ranges were at 200 yards, 1,000 yards, and one mile; and although nothing positive can be stated, as the official report has not yet been made public by the Navy Department, it is confidently believed that the trial, which showed effective action of over 50 per cent of the shots fired, will be a triumph for the company that has so boldly attempted to solve the problem of projecting large masses of high explosive at a sufficient rate of speed to insure accuracy in the flight of the shell containing the explosive. Should the trial be considered as not satisfactorily answering every requirement of the specifications, it would be some two weeks before another trial could take place, owing to there not being a sufficient number of projectiles on hand. The official table of data of the trial, including the range of each projectile, is given below. It will be seen from the column of ranges that five projectiles fell within a rectangle of 50 feet by 100 feet, or the limits specified by the contract. These shots were Nos. 1, 4, 5, 6, and 9 in the order of firing. There being nine shots fired in all, it is seen that 50 per cent came within the rectangular limits. But the question is, Will the board consider the spirit of the contract fulfilled by the above, or, if the members do report favorably on the gun's accuracy, will the secretary of the navy demand a second trial and a rigid adherence to the contract provisions, as shown in the report of the trial? The following is the official table of Saturday's trial:—

| No. of Fire. | Ranges. | Weight of Projectile. | Loss of Pressure. | Time of Flight. |
|--------------|---------|-----------------------|-------------------|-----------------|
| 1            | 2,177   | 450                   | 125               | Lost.           |
| 2            | 2,017   | 452                   | 122               | 11 3/4          |
| 3            | 2,009   | 453 1/2               | 105               | 12 1/4          |
| 4            | 2,159   | 451 3/4               | 123               | 12              |
| 5            | 2,156   | 445                   | 125               | 11 1/2          |
| 6            | 2,127   | 448 1/2               | 123               | 12*             |
| 7            | 2,055   | 454                   | 110               | 11 2-5          |
| 8            | 2,090   | 483                   | 220               | 13              |
| 9            | 2,154   | 440                   | 125               | 12 4-5          |

\* Approximate.

The elasticity of the requirements under which the trial was conducted may permit of the above being taken as satisfactory to the government, inasmuch as the firing at the 1,000 and 200 yards' ranges in itself proved the accuracy of the new guns.

ALL SCIENTIFIC MEN in government employ whose works will pass through the Government Printing-Office will be gratified, that, by the common consent of those who know him best, Alexander R. Hart of this city has been put forward as the best qualified and most available candidate for public printer under the new administration. For several years he has prepared engravings and illustrations of a scientific nature for the Smithsonian Institution, the United States Fish Commission, and other departments of the government. He has long been at the head of one of the best-organized and most thoroughly equipped printing and engraving establishments in this city, if not in the world. He is acknowledged to be a man of splendid executive ability, and he possesses a thorough knowledge of the printing and engraving business, down to the most minute details. He has worked his way from the foot of the industrial ladder by just such qualities as fit him for the position now suggested for him, where he would command the respect not only of those under his supervision, but also of all others who, socially or officially, should be thrown into contact with him.

SOMETHING ABOUT TORNADOES.<sup>1</sup>

WHERE atmospheric equilibrium is violently discomposed and the agitation covers but a very limited area, the centripetal force becomes much greater than in the case of cyclones. The gyrations are exceedingly rapid and very near the centre; in fact, the violence is greatest at the centre, and diminishes rapidly to the external parts of the disturbance, where the gyrations cease altogether. This form of disturbance is called a tornado. In order that conditions may become favorable for tornadic development, the atmosphere must assume the unstable state. This state will be engendered whenever the rate of decrease of temperature is greater in the surrounding quiet air than it is in the mass of ascending air. The adverse or counter movement of northerly and southerly winds induces the unstable state, because it makes the rate of decrease of temperature greater in the quiet air than in the column of ascending air; that is, the upper strata of the air will be made colder, and the lower strata warmer.

What are known as local storms, under this class of motions of the atmosphere, are not affected by the rotation of the earth upon its axis, because the area of disturbance is too small. The progressive motion of tornadoes to the north-east arises from the fact, that, as they always form in the south-east quadrant of an area of low barometer, they must come within and under the influence of the general drift of the atmosphere on that side of the "low," which, according to the law of atmospheric circulation about the centre of an area of low pressure, is always to the north-east.

The condition of tornado-formation in regard to heat is simply that of unstable equilibrium for saturated air at the existing temperature, the other condition being that the air shall have a gyratory motion relative to some central point, arising from any cause whatever. In the unstable state, the lower strata of the atmosphere are liable to burst up through the upper layers at any point where there may chance to exist some slight predetermining cause, which is never wanting, arising from local conditions of temperature and moisture.

When an upper motion of the atmosphere is started at any point, the air thus engaged is kept warmer, and therefore rarer, than the region immediately surrounding it. This continues as long as the ascending current is supplied with air nearly or quite saturated, or until, from an inversion of the air in the lower strata, the state of unstable equilibrium is changed. The violent whirling motion of the air which characterizes the tornado is dependent upon a pre-existing disturbed and gyrating state of the atmosphere. The case is somewhat similar to that of water in a shallow basin running out through a hole in the centre. If the initial state of the water is that of perfect rest, it flows directly toward the centre with a very slow velocity; but, if there is the least initial disturbance of a gyratory character when the water first begins to flow, it soon runs into rapid gyrations around that centre.

As we have shown, therefore, there are two principal conditions upon which the occurrence of tornadoes depends, and in the absence of either of which they cannot take place. The one is the state of unstable equilibrium of the air, and the other a circulation motion with reference to any centre of disturbance. It is not imperative that the central area shall be stationary, but simply that the motion of the air around it shall be such that when the latter is drawn in toward the centre it will take a gyration around it. When these two principal conditions are present, there is scarcely ever wanting the secondary condition, which, through the effect of some slight initial disturbance, gives rise to an upward burst of the air through the overlying strata. The places and time most favorable to the development of unstable equilibrium and a gyratory motion of the atmosphere are those in which tornadoes are most likely to occur. Of these two conditions, the unstable equilibrium is the most important, since it more rarely occurs than the other, which is scarcely ever so entirely absent as not to give some slight gyratory motion, which becomes violent very near the centre. The question naturally occurs, Where are the places on the earth's surface, and what is the time when conditions are most favorable for the development of tornadoes?

First, as to places. These are found where, in the general motions of the atmosphere as affected by continents and mountain-ranges, currents of the air at the earth's surface, which come from a warmer latitude, or at sea from a much warmer continent, are caused to flow under the colder upper strata, where the normal motion is nearly eastward, and where consequently the temperature is the normal one, not affected by such motions as take place in the lower strata: in other words, tornadoes are most likely to occur in regions where warm, moist air flows underneath a colder and dryer upper strata, coming from another direction. Such regions are found particularly in the Mississippi, Missouri, and Ohio valleys, and in Alabama, Georgia, and the Carolinas. The other condition of the atmosphere indispensable to the formation of tornadoes — viz., a relative gyratory motion with regard to any point — is found to an unusual extent in the regions above named, especially in the winter season, which fact accounts for the frequent occurrence of tornadoes in the Southern States during the winter and spring, and occasionally in the Mississippi and the Ohio valleys.

Second, as to time. The summer season is the most favorable for tornadoes, when the interior of the continent is warmed up, and the air of the lower strata is drawn from lower latitudes far up into the northern portions of the country on the eastern side of the Rocky Mountains, and the isothermal curve is deflected very decidedly toward the north. From this cause the temperature of the lower strata of this region becomes much higher than that of the superdominant strata; and, if this condition does not of itself induce the unstable state, it is readily accomplished by the addition of any small effect from some other cause, as from extremely warm weather, in which the earth's surface and the lower air strata become abnormally heated.

The great moisture of the air in the southerly winds is also favorable to the induction of the unstable state, since such a change is more readily brought about in air nearly or quite saturated. The southerly currents curving eastward from the Rocky Mountain and Appalachian ranges give rise to a general air movement of considerable force toward the Atlantic Ocean, as the result of which, cold counter currents pass southward to Texas, east of the Rocky Mountains, and to Florida over the Appalachian range, somewhat after the manner of the Arctic currents which flow southward to Florida, between the Gulf Stream and the coast of the United States.

In the summer season this flow of cold air southward is confined to a comparatively narrow belt east of the Rocky Mountains, for at that time the warm, moist currents of the Gulf are drawn very far to the north and west. At this season the northern part of Texas has the same mean temperature as Minnesota, the isotherms being nearly north and south in direction; and the temperature gradient between the warm southerly winds on one side, and the cold northerly currents on the other, is similar to that of the cold wall between the Gulf and Arctic currents.

In the winter and spring the flow of cold air southward from the higher latitudes extends to the Appalachian range, where it overflows the warm, moist southerly currents from the East Gulf and South Atlantic coast. It is this tendency of the air to flow in contrary directions, where the conditions are most favorable to produce the unstable state of the atmosphere, that pronounces the regions here indicated as the "battle-ground of tornadoes." The word "low," as is quite well known, marks upon the weather-map the centre of lowest pressure as indicated by the barometer and direction of the wind. This is practically the centre of the general storm or atmospheric disturbance.

1. The conditions for the development of tornadoes are most favorable in the south-east quadrant of a "low:" in fact, they are not to be looked for in any other portion of the general disturbance. 2. Tornadoes very generally accompany a "low," for the reason that the condition of unstable equilibrium necessary in the formation of a tornado is also required in the "low," at least in the upper cloud-region. 3. The unstable state in a "low" very rarely extends down to the earth's surface, so that tornadoes are not necessarily visible in every general storm. 4. There are frequently secondary whirls, incipient tornadoes, in the cloud-region of a "low," the effects of which do not reach down to the earth's surface, and the only visible effect above is the formation of a local

<sup>1</sup> Portion of a paper read before the National Geographic Society of Washington, Nov. 16, 1888, by J. P. Finley.

cloud a little denser and darker than the clouds are generally. 5. A hail-storm is an incipient tornado in the cloud-region of a "low." 6. Tornadoes always occur in the south-east quadrant of a "low," and at distances generally of from 200 to 500 miles from the centre. They are not likely, however, to occur in the south-west and north-west quadrants of a "low," because the currents and counter currents there are nearly east and west; and hence the effect is neutralized, tending neither to produce nor destroy the unstable state. As the "low" progresses eastward, the region of country lying, on the average, about 350 miles to the south and east of the centre of the general storm at any time, is the region within which tornadoes may be expected.

The destructive violence of a tornado is sometimes confined to a path a few yards in width, or it may widen to the extreme limit of eighty rods. The tornado, with hardly an exception, occurs in the afternoon, just after the hottest part of the day. The hours of greatest frequency are 3.30 to 4 P.M., and 4.30 to 5 P.M. The destructive power of the wind increases rapidly from the circumference of the storm to its centre. Observations with a single barometer will not indicate the approach of a tornado, however near the position of the instrument to the path of the storm; and such observations are of value in this connection, only when a number of them are displayed upon the weather-map. The tornado season includes the months of March, April, May, June, July, August, and September. There are, however, cases in a long series of years where tornadoes have been reported every month of the year. The months of greatest frequency, as determined from a record of 206 years, are April, May, June, and July. The month of greatest frequency is May, April coming next on the list. The State in which the greatest number of tornadoes have occurred is Missouri, followed next in order by Kansas and Georgia. The 425 tornadoes and "windfalls" recorded in Wisconsin far exceed the number from any other State; but little weight can be given this fact, owing to the want of a similar investigation of the subject of "windfalls" in other States. The violence of tornadoes expressed relatively by States places Missouri first, succeeded by Iowa and Alabama. By "violence" in this sense is meant the most completely developed storms with perfect conditions longest sustained.

Considering the entire record of eighty-eight years (years of record from 1682 to 1888), nearly 4,000 persons have been reported killed, and 6,000 injured. This record is very imperfect, owing to the large number of cases in which the killed and wounded were not definitely reported. The States in which tornadoes have proved the most destructive to life are in relative order as follows: Missouri, Mississippi, Iowa, Illinois, Minnesota, Wisconsin, and Ohio.

Considering the reported valuation of property destroyed, the following States have experienced the most destructive storms, and in the order named: Missouri, \$94,325,000 in forty-seven years; Ohio, \$87,737,500 in eighty-four years; New York, \$67,000,000 in one hundred years; Kansas, \$64,000,000 in twenty-nine years; Georgia, \$56,500,000, in ninety-three years; Minnesota, \$50,750,000 in thirty-three years; Iowa, \$49,575,000 in forty-five years; South Carolina, \$46,875,000 in one hundred and twenty-seven years. These values are necessarily approximate, owing to the imperfect reports, and it is believed that they fall considerably short of the actual amount of loss.

It is a difficult matter to obtain reliable estimates of the actual value of property destroyed by tornadoes in the United States, since the date of the earliest records; viz., June, 1682. Although the average yearly occurrence of these storms has probably remained unchanged, and will continue so, yet the value of the property subject to destruction by them has increased enormously, and the amount is constantly enlarging as the country advances in wealth and population. Where fifty years ago the tornado swept a barren plain or trackless forest, it now crushes and overwhelms prosperous cities, and devastates rich and populous agricultural districts.

The approximate aggregate loss to property by tornadoes, considering the number of storms reported, is nearly one billion of dollars. Considering the number of years embraced in the period of observations and the average yearly number of tornadoes, the amount is nearly ten billions of dollars. This estimate is probably

in excess of the actual loss, because no allowance is made for the many storms which have occurred since 1682 without appreciable waste. Taking the past thirty years as affording more satisfactory information, and considering the average yearly occurrence of tornadoes as 146, the approximate aggregate property loss foots up about two billions of dollars.

A comparison of yearly values, as obtained from carefully prepared tables showing the number and geographical distribution of tornadoes, might lead one to the conclusion that these storms were on the increase. Such a deduction would certainly be erroneous, and for the following reasons. First, From a careful investigation of the origin of tornadoes and their geographical distribution, there is every reason to believe that these storms were as frequent and violent two hundred years ago as now. Moreover, there appears to be no cause for any unusual change in the annual frequency of tornadoes for a like period to come. Second, It must be considered that during the past ten years the Signal Service has had great facilities for collecting reports; and the rapid growth of the country, with a greater zeal of the press, has brought to light the occurrence of many storms which otherwise would not have been reported. Third, The statistical tables are not sufficiently complete, especially prior to 1875 (without which period it would not be safe to make deductions), to permit of reliable conclusions as to periods of maximum and minimum occurrence. It is not unlikely that such variations exist, and that they depend upon the relation of heat and moisture to the general condition of the atmosphere. The more frequently the unstable state of the atmosphere is produced, together with a relative gyratory motion, the more favorable are the conditions for the occurrence of tornadoes, and *vice versa*. Fourth, In the region between the 95th and 107th meridians, tornadoes still occur without causing much damage, because of their passage over thinly settled portions of the country. Owing to this fact, little attention is given to these storms; but this indifference will soon disappear, as the country rapidly settles up and every appearance of the cloud-monster is marked by death and destruction. Fifth, The years (118) that are missing in the period of 206 years from 1682 to 1887 inclusive are not to be considered as years in which no tornadoes occurred, but as years in which records are wanting owing to failure of observations.

Considering the past ten years (1878 to 1887 inclusive) as furnishing reliable and exhaustive records of tornadoes, and that the period prior to 1878 (196 years, 1682 to 1877 inclusive) is deficient owing to want of facilities in collecting reports, we may give an interpolated value for each of these latter years, as determined from the complete ten-year record. This value is found to be 146, which means, that, on the average, 146 tornadoes will occur in the United States.

Applying this constant to existing records, we have a grand total of storms from 1682 to 1887 inclusive (206 years) of 30,076 tornadoes, instead of 2,435 actually observed and reported. This would indicate a failure to report the occurrence of about 27,641 tornadoes which have probably passed over portions of this country since 1682. In that year a very destructive tornado, with distinct funnel-shaped cloud, visited New Haven, Conn., at 2.30 P.M. on the 10th of June. It is the very long interval of 118 years, during which records are entirely missing, that makes the discrepancy so great in the grand totals.

No well-authenticated case of a tornado has been reported from the region of country lying west of the 105th meridian, and it may be generally stated that these storms do not occur in the United States west of the 100th meridian. The cause for this is found in the lack of favorable conditions, on account of the dryness and the lower temperature of the air, and the want of uniformity in the direction and force of surface currents. Violent straight winds, attended with considerable destruction to property, have been reported several times in the past fifteen years, from southern and central California, Arizona, New Mexico, and Montana.

Much has been said and published concerning the influence of forests upon the occurrence and destructiveness of tornadoes, and many people believe that where timber grows in great abundance, tornadoes cannot occur. By comparing the number of tornadoes in each State with the acreage of forests, as estimated in the last census report, it is found that the latter appear to have no percep-

tible influence in preventing the occurrence of tornadoes, or in assuaging their violence.

In this connection, it should not be forgotten that the conditions which give rise to the development of tornadoes exist in the cloud-regions of the atmosphere, and not at the surface of the earth. Forests would prevent the occurrence of whirlwinds, because these phenomena depend upon the unstable state of the atmosphere at the earth's surface, where the conditions are favorable for the sun's heat to accumulate in the surface strata of the soil, and thus super-heat the air resting upon it. A heavy growth of timber or rank vegetation will prevent this action of the sun's rays.

Whenever a tornado-cloud encounters a forest, the destruction is complete and terrible. The forces of the tornado-cloud are quickly brought into operation, and maintained continuously while the phenomenon exists. They are not affected by having to meet in rapid succession totally different objects, different in size, strength, shape, materials, composition, structure, relative position, etc.

The width of the path of destruction, as determined from the records of 88 years, varies from 10 to 10,560 feet, the average being 1,369 feet. The length of the tornado-track varies from 300 yards to about 200 miles, the average being 24.79 miles. The velocity of progression of the tornado-cloud varies from 7 to 100 miles per hour, the average being 44.11 miles. These extremes may often occur in different portions of the track of a single tornado. The shortest time occupied by the tornado-cloud in passing a given point varies from "an instant" to about 20 minutes, the average being about 74 seconds.

The month of greatest frequency, that is, the month embracing the largest number of days in which tornadoes occurred, is May. The prevailing direction of the progressive movement of the tornado-cloud is north-east. The vortex wind velocities of the tornado-cloud vary from 100 to 500 miles per hour, as deduced from actual measurements. Velocities of from 800 to 1,000 miles per hour are extremes that have been reported, but may not be altogether reliable. Theoretical velocities of 2,000 miles and over per hour, based upon certain assumed atmospheric conditions, have been deduced. Such velocities are mathematically possible, but not meteorologically probable.

The concomitants of the tornado are, an oppressive condition of the air; the gradual setting-in and prolonged opposition of northerly currents and southerly currents over a considerable area; a high temperature, and the presence of considerable moisture; a gradual but continual fall of the thermometer with the prevalence of northerly currents, and a rise with the predominance of southerly; a rapid decrease of temperature with increase of altitude; a decided gradient of temperature across the line of progressive movement; huge masses of dark and portentous clouds in the north-west and south-west, possessing a remarkable intensity of color, usually a deep green; a remarkable rolling and tumbling of the clouds, scuds darting from all points of the compass towards a common centre; hail and rain accompanying the tornado, the former either in unusual size, form, or quantity, and the latter either remarkable in quantity or size of drops; the presence of ozone in the wake of the tornado; a remarkable roaring noise, like the passage of many railroad-trains through a tunnel.

The cloud generated by the vortex assumes the form of a funnel, with the smallest end towards the earth. This explains the remarkable contraction of the storm's path. Upon reaching the earth's surface, the vortex has four motions: viz., first, the whirling or gyratory motion, always from right to left; second, the progressive motion, generally from some point in the south-west quadrant to some point in the north-east quadrant; third, the curvilinear motion; fourth, oscillatory motion.

The characteristic effects of a tornado are, objects are drawn towards the vortex from every point of the compass; objects passing into the vortex are thrown upwards and outwards by the vortical action of the engaged air; structures are literally torn to pieces by the vortical action of the air, evidence of which is afforded by the fineness of the *débris*, and also its disposition in the storm's path; the *débris* is thrown inward from each side of the storm's path; light objects are carried to great heights and also to great distances; objects are carried inward and upward by the centripetal, and outward by the centrifugal, forces of the vortex; weight

and size are conditions which generally present immaterial values to the power of the tornado; persons are stripped of clothing; fowls and birds are denuded of feathers and killed; trees are whipped to bare poles; heavy objects are carried for miles in the air; long and heavy timbers are driven to considerable depths in the solid earth; the vortex is completely filled with flying *débris*; timbers are driven through the sides of buildings; sand and gravel are driven into wood; the strongest trees are uprooted, or twisted off near the roots; men and animals are terribly mangled by contact with flying *débris* and by being rolled over the ground for a considerable distance; in the path of the storm all vegetation is destroyed; railroad-trains are thrown from the track; iron bridges are completely dismantled and carried from their foundations; heavy bowlders, weighing tons, are rolled along the earth; the largest railroad-engines are lifted from the tracks on which they rest; all objects, whether metal or non-metallic, magnetic or non-magnetic, simple or compound, animate or inanimate, are acted upon in a similar manner.

#### THE SITUATION IN SAMOA.

THE continuous disturbances on the Samoa Islands, and their bearing upon questions of great political importance, give to these islands a special interest. The group consists of thirteen islands, only three of which are of commercial interest, — Savaii, Upolu, and Tutuila. Savaii is the largest island of the three, measuring some 40 miles from east to west by 20 miles from north to south, and having an area of 700 square miles. It has no harbor of any importance, and in this respect it contrasts strongly with Upolu and Tutuila. The little bay of Mataatu, in the extreme north of the island, is the only place where large vessels can anchor; but even it is not safe from November to February. The interior of the island is occupied by two mountain-ranges of volcanic origin. It has no rivers or streams, the water filtering away through the porous soil. Where the mountains approach the coast, the latter is very steep and inaccessible, while in other places a well-wooded strip of alluvial land is found, on which numerous villages are situated. The sterility of the interior of this island has always been a barrier to all settlement or cultivation, and even to the visits of travellers and explorers.

Upolu, which covers an area of 550 square miles, is also mountainous, but it is well wooded and fertile, and possesses several considerable streams, although they are, of course, not navigable. On the northern coast of this island lies Apia, the chief town of the whole Samoan group. It is prettily situated, having a background of mountains thickly wooded, and a foreground of harbor and coral reefs. The harbor consists of two portions, the most westerly being the best for vessels that intend to remain for any length of time, especially during the rainy season. For sailing-craft, a steady breeze is absolutely necessary on entering or leaving the harbor, as a strong current sets along its entrance.

Passing down the coast east of Apia, a succession of beautiful bays are met with. At the distance of from half a mile to two miles from the shore a coral reef protects this portion of the island for nearly twenty miles. At high tide canoes and boats can pass between this and the mainland, and thus a great deal of the insular traffic is carried on.

As seen from the sea, there are not many islands in the Pacific that present a more beautiful or picturesque appearance than Upolu. It shows a bold and majestic front, the central range being not less than 3,000 feet high, and wooded almost to its summit. It is throughout a very fertile island, and fully equal to the best portions of the Fiji group.

Tutuila is about 17 miles long and 5 broad. On its southern side is the deep bay of Pagopago, which almost cuts the island in two. This harbor, which is one of the best in the whole South Pacific, is surrounded by hills from 2,000 to 3,000 feet high. Surrounding the harbor at their base is a small strip of level land. The harbor is half a mile wide at its entrance, and runs north and south for a distance of a mile, when it turns in a westerly direction, and opens out into a fine sheet of water. It is somewhat difficult for sailing-vessels to leave, in consequence of the trade-winds blowing directly into it; but for steamboats it is unsurpassed by





the poison was developed after the milk had been delivered. This was also found to be the fact on questioning the servants of the family poisoned. The milk had been received in a tin can, which it was their business to keep clean, and it had been immediately subdivided into two portions. One portion was placed in an earthen dish to raise cream, and the other was used during the same morning as fresh milk, without causing the slightest trouble. The symptoms of poisoning were caused by the first portion, after standing over night. The above facts seem to show that the tyrotoxin was developed during the twenty-four hours after the milk was received.

The only explanation of its development that can at present be given is, that the cans used for obtaining the milk had not been thoroughly scoured with boiling water, and that a little old milk remaining on the inside edges of the can had undergone a peculiar fermentation, and had caused the development of a sufficient amount of tyrotoxin, during the twenty-four hours it had remained in a cool place, to produce the poisonous action.

Professor Kinnicutt describes thus fully the above case, as up to this time almost nothing is known as to the cause of the formation of tyrotoxin in milk. He has, he thinks, pointed out one way in which it may be developed, namely, the use of cans which have not been kept perfectly clean; but it is only by the careful examination of a number of cases that it will be possible to decide whether the formation of the poison is due solely to such causes.

THE PASTEUR INSTITUTE.—The Paris correspondent of the *New York Medical Record* contributes to that journal an interesting letter describing the opening of the Pasteur Institute, which occurred Nov. 14, in the presence of a large assembly presided over by the President of the Republic. The proceedings were opened by M. Bertrand, permanent secretary of the Academy of Sciences, who made a eulogistic speech on M. Pasteur and his numerous scientific researches. Dr. Grancher, M. Pasteur's principal assistant, then read a report of the work done in antirabic inoculations since the middle of 1885, when the first two human beings were inoculated. He stated that the number of persons treated at Paris in the Rue d'Ulm and the Rue Vauquelin during the years 1886-87 to July 31, 1888, was 5,384. The rate of mortality had been 1.34 per cent for 1886, for 1887 it was 1.12, and for 1888 it was 0.77 per cent. This rate of mortality comprises the deaths of persons who were affected with rabies the day after inoculation; but, remarked Dr. Grancher, even these figures are very striking, as the estimated mortality previous to the discovery of this method of treatment was 15.90 per cent as given by the reporter of the Council of Hygiene of Paris. Dr. Grancher informed his hearers that twenty laboratories for antirabic inoculations have been established in different parts of the world,—seven in Russia, five in Italy, and one each in Roumania, Austria, Brazil, Cuba, and the Argentine Republic,—while two more will shortly be opened at Chicago and Malta. The staff of the new institute are disposed of as follows: Dr. Grancher, with the assistance of Drs. Chantemesse, Charrin, and Terrillon, will attend to the department of the treatment of rabies; M. Duclaux, one of M. Pasteur's most ancient pupils, and now professor of biological chemistry at the Faculty of Sciences, will direct the laboratory of general microbiology; M. Chamberland is charged with microbiology in its relations with hygiene; Dr. Roux will teach the microbial methods in their applications to medicine; Drs. Metchnikoff and Gamaleïa of Russia will study the morphology of inferior organisms and comparative microbia. The new institute will thus, as expressed by M. Pasteur, serve as a dispensary for the treatment of rabies, and will at the same time constitute a centre of researches for infectious maladies, as well as a centre of instruction for the study of microbiology, and will be open to medical men of all nationalities.

IS THE RACE DEGENERATING?—An English newspaper has been making a collective investigation regarding the questions given below: "1. Does your experience suggest to you that the race of Englishmen is degenerating physically? 2. Do you think that the great advance in the healing art is responsible for keeping alive much weak life that will in time affect the whole race injuriously? 3. Do you think that the increased indulgence in physical sports has, on the whole, a good influence on health? 4. Has it ever

struck you that probably the great attention paid to health in these days may be producing an anxiety about bodily ailments which is a disease in itself?" Answers have been received from a long array of practitioners, among whom are the names of eminent London physicians. The general view taken, according to the *Medical Record*, is that Englishmen are not degenerating, but that, on the whole, the race is improving in vigor.

TO INVESTIGATE DISEASES OF SWINE.—The commissioner of agriculture has appointed a commission, consisting of Professor William H. Welch of Johns Hopkins University, Dr. E. O. Shakespeare of Philadelphia, and Professor T. J. Burrill of the University of Illinois, to investigate the subject of swine-diseases in the United States, and the methods of their treatment and prevention.

## MENTAL SCIENCE.

### A Statistical Study of Sleep and Dreams.

THE application of general scientific methods to the problems of mental action has everywhere brought results of interest and value, and especially pleasing has been the success attending the study of the statistics of mental phenomena. Observations in themselves trivial, apparently accidental even, when intelligently grouped together, bring to light truths only dimly suspected and poorly understood. The errors of individuals in part disappear in the average, and results obtained by one method are controllable by others. A very striking innovation, with the help of the statistical method, into an obscure region of mental action, is attempted in a recent study coming from the University of Dorpat, Russia.<sup>1</sup> A series of questions were drawn up, and five hundred copies distributed. Of these, over four hundred were returned filled out; and it is upon these answers, which the author declares unexpectedly clear and accurate, that the conclusions of this paper are based.

Each observer, after stating his name, age, sex, and occupation, set himself to answering the following questions regarding his sleep and dreams. The persons were divided into three classes: 1. Students (151 in number); 2. Other males (113); 3. Females (142).

#### I.—Dreams.

1. Do you dream every night, frequently, seldom, never? "Nearly every night" was grouped with "every night," making 99 such answers; "frequently," "very frequently," etc., were reported 133 times; "seldom," etc., 153 times; and "hardly ever," or "never," 15 times; 6 were undecided.
2. Are your dreams vivid? This was answered affirmatively 216 times; negatively, 175; undecided, 15.
3. Can you well remember your dreams upon awakening? "Yes," 194; "no," 203; "undecided," 9.

#### II.—Sleep.

1. When do you go to bed?
2. When do you rise?
3. Are you tired in the morning upon awakening? Do you become tired early in the evening? 38 were tired both morning and evening, 104 in the morning only, 95 in the evening only, 169 at neither time.
4. How long does it take you to fall asleep? This question is difficult to answer, and the general tendency will be to overestimate the time; and this was partly taken into account.
5. Do you sleep through the night without awakening? "Yes," 261; "no," 143; "undecided," 2.
6. Is your sleep deep, or light? Is it easy, or difficult, to wake you? "Light," 202; "deep," 166; and 26 reported "deep sleep, but easy to wake."
7. Can you go to sleep at day-time when desired? "Yes," 103; "no," 294; "undecided," 9.
8. Are you accustomed to sleep at day? When and how long? This question was used with Nos. 1 and 2 to obtain the duration of sleep per twenty-four hours.

<sup>1</sup> Statistische Untersuchungen über Träume und Schlaf, von Friederich Heerwagen, in Philosophische Studien, v. 2, 1888.

### III.—*Work, Disposition.*

1. When is mental labor easiest to you? "In the forenoon," 182; "late in the afternoon," 6; "at evening and night," 133; "forenoon and evening," 43; "no difference," 28.

2. What is the nature of the work? The object was to ascertain whether the kind of work limited the time of doing it, but the question was not successfully formulated.

3. Do you suffer with nervous disorders (headache, uneasiness, moodiness)? A decided "no" was given only 18 times; "seldom," 196; and "yes," 210.

4. Is your temperament sanguine, choleric, phlegmatic, or melancholic? "Sanguine," 132; "choleric," 70; "phlegmatic," 74; "melancholic," 20; various combinations, 102.

The results for the two sexes were so different that they demanded separation, while the students formed a homogeneous class interesting as a special study. The first problem that was proposed was the relation between the frequency and the vividness of dreams. It appears that 62.5 per cent of those who dream every night dream vividly, 60.5 per cent of those who dream frequently, and only 26.8 per cent of those who dream seldom, showing that the vividness of dreams increases very markedly with their frequency.

Next, how is the intensity of sleep related to the frequency of dreams? Of the students who dream nightly, 68 per cent have a light sleep (and only 28 per cent a deep sleep); of those dreaming frequently, 40 per cent; of those dreaming seldom, 32.8 per cent. Similar percentages for the other males are 68.8, 42.1, and 39.3; and for women, 72.4, 60, and 50 per cent. We conclude, then, that frequent dreams are a concomitant of light sleep, though the relation is far from universal.

These are the questions that formed the starting-point of the investigation. The rest of the information is grouped together in one large table and an admirably arranged diagram, from which more conclusions can be drawn than can find mention in this *résumé*. Those that the author singles out may be noted.

As regards sex, women have 73 per cent of their number dreaming nightly or frequently, while students have only 50 per cent, and the other males 48 per cent. Again: 63 per cent of the women sleep lightly, and only 42 per cent of students, and 44 per cent of other males. We conclude, then, that women have a very much lighter sleep than men, and that their dreams are proportionately more frequent.

Another conclusion, the evidence of which is too detailed to present, is, that as we grow older, our dreams become less frequent, but our sleep becomes lighter; age affecting the intensity of sleep more than the frequency of dreams. The author regards the students as in the period of maximum dreaming (twenty to twenty-five years of age). The deep sleep of childhood (hostile to frequency of dreams) is then least counterbalanced by the lessening of dreams due to age. The vividness of dreams shows a similar relation to age and sex: the women dream most vividly; the students, being younger than the other men, have more vivid dreams. The power of remembering dreams is also dependent upon vividness and frequency of dreaming: it is accordingly greatest in women, and greater in students than in more mature men. The liveliness of the emotional nature, a prominent feature of women and youth, seems thus to be marked out as the causative agent in the production of dreams.

The duration of sleep should naturally be related to the habit of dreaming, but in the men no such relation can be discovered. In the women, however, it appears that those who dream frequently sleep nearly an hour longer than those who seldom dream. This difference is regarded as due to the fact that men are more under duty to break short their sleep, and thus vitiate the statistics. This is corroborated by the frequency with which the men who dream frequently declare themselves tired in the morning, indicating incomplete sleep. The need of sleep is greater in women than in men; the duration of sleep being longer, and the percentage of "tired morning and evening" and of "not tired" being 3 to 2 and 2 to 3 respectively as compared with the men. Students sleep longer, and are less tired, than other men.

The time needed to fall asleep is about the same in all three classes,

— 20.8 minutes for the men, 17.1 minutes for students, and 21.2 minutes for women. In each case, however, it takes longer for those who are frequent dreamers and light sleepers to fall asleep than persons of opposite characteristics. Eighty per cent of students sleep uninterruptedly through the night, 70 per cent of other men, and only 43 per cent of women. Light sleep and frequent dreams increase the interruptedness of sleep.

The power of falling asleep at will is possessed by few. It is greater in youth than in age. Twenty-eight per cent of men, 19 per cent of students, and 20 per cent of women sleep in the afternoon, indicating a making-up of insufficient sleep on the part of the men.

The effect of dream-habits upon mental work is also evident. Those who dream seldom, or sleep deeply, are better disposed for work in the forenoon than light sleepers and frequent dreamers. The forenoon seems in general to be the preferred time of work.

The statistics regarding nervousness confirm the accepted fact that this is greater among women than men. It is greater among students than among men at large. It is, too, a concomitant of light sleep and frequent dreams. As to temperament, the phlegmatic people are quite constantly deep sleepers and infrequent dreamers.

Finally, a contrast between teachers and professors of the same average age shows the effect of occupation. The teacher, with his daily toil, has a lighter sleep and more frequent dreams; while the professor, leading a comparatively congenial and worriless life, is a deeper sleeper and a less frequent dreamer. This, perhaps, is related to the lack of visualizing power that Mr. Galton found to be current among men of science.

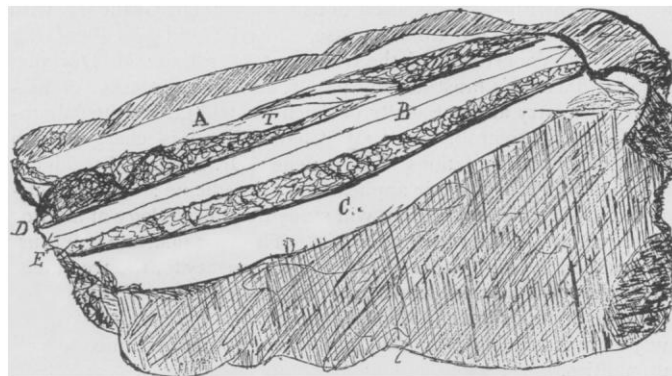
The relation between depth of sleep and frequency of dreams seems explicable on the supposition that the insensitiveness to outside excitations present in deep sleep, also induces insensitiveness to internal impressions. The threshold of mental life is raised. If the normal psychical activity is great, then, even in a deep sleeper, will the dreams be frequent, thus accounting for the exceptions.

In addition to the interesting results that this study has brought out, it increases one's sense of the utility of such inquiries, and shows the truth of Galton's experience, indorsed by the author, that "it is a much easier matter than I had anticipated to obtain trustworthy replies to psychological questions."

### ETHNOLOGY.

#### Jade in Alaska.

LIEUT. G. T. Emmons, who is continuing his interesting researches in Alaska, recently made an interesting find at Sitka. He writes: "A boulder of jade was dug up on the site of the present Indian village, at a depth of some three feet in loose black soil. Two pieces have been cut from it for knives or adzes, each about



20 centimetres long, from 3 to 4 centimetres wide, and from 1 to 1.5 centimetres in thickness. The three faces on which the boulder has been cut are highly polished, and show a mottled green surface, ranging in color from a yellow green to a rich dark green. After the pieces were cut down on either side, they were broken from the body of the boulder by a shock, probably by means of a wedge. On another side, where a wedge-shaped adze could be re-

moved with the least work, a cut has been commenced, forming a somewhat irregular groove, following to some extent the irregular surface of the boulder. It is 12 centimetres long, and 0.2 of a centimetre deep. From inspection, I should say it had been worked by means of a stone knife or the edge of some silicious rock not having a cutting edge of more than 2 or 3 centimetres at the greatest. The whole boulder is wedge-shaped, and 29 centimetres in length. Its weight is a few ounces less than 20 pounds. The four faces are of olive green, the more prominent rounded surfaces being veined with a rich dark green. In my collection in the American Museum of Natural History there is a small nugget about the size of a hen's egg, with a groove in it; a dark green jade; and I have also in my possession a piece of unworked jade of a rich sea-green, which I found an Indian wearing as a scratcher. It has well-rounded edges and well-polished surfaces, proving long wear. Among forty-three pieces I have collected among the Tlingit, these are the only ones that show that jade has been worked on the spot. Jade has been used for implements, generally for adzes, axes, or fighting-picks, the last mounted in wooden handles."

The finding of this boulder of jade showing worked surfaces is important, as it proves that the material was found and worked in southern Alaska. It will be remembered that Dr. G. M. Dawson found a boulder of the same description on the lower Fraser River, and that Jacobsen and Dawson found boulders of this material, although the rock has not been found *in situ*. Lieut. Emmons adds that he is very hopeful of finding the exact locality from which the Alaskan jade is obtained, as he received trustworthy information referring to this interesting question from the natives.

NAVAJO INDUSTRIES. — While in former years the "Proceedings of the United States National Museum" contained almost exclusively essays on zoölogical, botanical, and geological subjects, in the new volume, which is being issued in signatures, much attention is paid to ethnological points. To Professor Otis T. Mason's energetic endeavors we owe some interesting notes on the methods of manufacture among the Navajo, for Dr. Shufeldt's remarks on the method of preparing deer-skins by this people was written at his instance. The most interesting portion of this essay is the description of the process of tanning, which is done by means of a decoction of brains applied to the outer side of the skin after the hair has been removed. It is said that by this process the skin attains its softness and pliability. Mr. A. M. Stephen contributes some notes on the art of shoemaking and a myth explaining certain customs connected with this art. He tells that in olden times the Navajo used to wear grass shoes, until a deity came and taught them the art of making leather shoes. As this deity's face is gray, the Navajo must avoid looking at any thing gray, — for instance, the fresh-cut edges of a skin, — and therefore the latter must always be painted red, yellow, blue, or black.

#### BOOK-REVIEWS.

*Elements of Machine Design.* By J. F. KLEIN. Bethlehem, Penn., The Comenius Press. 8°. \$6.

*Gear Tables for laying out Accurate Tooth Profiles.* By J. F. KLEIN. Bethlehem, Penn., The Comenius Press.

In this work, Professor Klein, who is professor of mechanical engineering at Lehigh University, treats of the most important of the machine parts that appear in practice, giving their proportions and the main considerations governing their use and construction. The work is not, nor does it claim to be, a complete treatise upon the subject of machine design, but it is a series of notes and plates specially arranged for students of machinery desiring practice in designing the commonly occurring machine forms, and is well adapted, in extent and character, to the requirements of technical schools. It contains much that is new, including a diagram and tables for determining the diameter of stepped-cone pulleys, extensive tables of co-ordinates for laying out toothed profiles, a determination of the cross-sections of connecting-rods, and a method of finding belt-widths from their specific duty.

Pains have evidently been taken to make the work convenient for

reference. The symbols used in the formulas are placed in alphabetical order at the beginning of each chapter, which consists of a plate with its accompanying notes; the formulas are numbered; and the index is very full, being divided into four columns, referring respectively to pages, formulas, figures, and tables. To insure durability, the plates and gear tables are printed on strong bond-paper.

The first five chapters of the book are devoted to fastenings, including bolts and nuts, rivets and riveted joints, keys, and gibs and cotters. Seven chapters treat of gearing, toothed and belt. Of the remaining chapters, one each is devoted to rotating pieces, bearings, connecting-rods, and gear tables.

That portion of the book devoted to gear tables has been issued in separate form, for the use of pattern-makers, machinists, draughtsmen, and students of engineering. The tables are printed on both sides of one large card, 17 by 20 inches, so as to get them into compact form for use in the shop, draughting-room, or college. The use of the tables is made clear by examples worked out in detail, and illustrated by suitably drawn figures.

*The Secret Doctrine: The Synthesis of Science, Religion, and Philosophy.* 2 vols. By H. P. BLAVATSKY. New York, William Q. Judge. 8°.

THE connection between this work and science can only be shown on the Hegelian principle of the identity of contradictories; for it has not a single characteristic of a scientific treatise. It is a pure fiction from beginning to end, — a work of imagination, pretending to give an account of the creation and evolution of the world, but without even an attempt at proof. The nucleus of the book consists of some passages alleged to be taken from the "Secret Book of Dzryan," which, the authoress tells us, "is utterly unknown to our philologists, or, at any rate, was never heard of by them under its present name." And in her preface she says, "The writer, therefore, is fully prepared to take all the responsibility for what is contained in this work, and even to face the charge of having invented the whole of it." The passages from the "Book of Dzryan" are followed by an elaborate commentary; and that they need it will be evident from the following extracts, which relate to the beginning of creation: "The eternal parent wrapped in her ever invisible robes had slumbered once again for seven eternities. . . . But where was the Dangma when the Alaya of the universe was in Paramartha, and the great wheel was Anupadaka? . . . The root remains, the light remains, the curds remain; but still Oeaoohoo is one;" and so on for many pages.

When we inquire more closely into Mrs. Blavatsky's doctrine, we find it at bottom pantheistic. She holds to the existence of "an omnipresent, eternal, boundless, and immutable Principle, on which all speculation is impossible, since it transcends the power of human conception." Sometimes, however, she speaks as if this first Principle was the same as Space, which she calls "the seven-skinned eternal Mother-Father." To trace the evolution of the universe and of man from this first Principle is the object of this work, and is pursued through over fourteen hundred octavo pages, with more to come. We cannot undertake to give even the shortest abstract of the work, which reads like the Hindu and Babylonian cosmologies; but those who wish to see what antics the human imagination is capable of may profitably consult these volumes. There is one item, however, to which we must call attention. It seems that this occult and incomprehensible doctrine is connected with the Keely motor. We are told that there is in the universe a mysterious force capable of reducing a whole army to atoms in a few seconds; and "this great *archæus* is now discovered by, and only for, one man, — Mr. J. W. Keely of Philadelphia." It appears, however, that Keely is not destined to succeed with his discovery, because it "would lead to a knowledge of one of the most occult secrets, — a secret which can never be allowed to fall into the hands of the masses." We are also informed that "the secret teachings with regard to the evolution of the universal Kosmos cannot be given, since they could not be understood by the highest minds in this age;" so that we shall have to content ourselves with what Mrs. Blavatsky may reveal to us. The extracts we have here given, which might have been multiplied indefinitely, will give our readers a general idea of her work, and will show that whatever may be the value of her "science, religion, and

philosophy," she has at least made a considerable contribution to humorous literature.

*Healing Question.* By SIR HENRY VANE. (Old South Leaflets. No. 6.) Boston, D. C. Heath & Co.

*The Fundamental Orders of Connecticut.* (Old South Leaflets, No. 8.) Boston, D. C. Heath & Co.

THESE little pamphlets relate to the beginnings of written constitutions. Vane's paper appeared at that time in the history of the English commonwealth when serious dissensions had arisen in what he calls "the honest party," and was written with the hope of settling the difficulty. It proposed the expedient, now so familiar but then first suggested, of a national convention to prepare a constitution of government by which both people and rulers should be bound. The proposal was not acted on by the people of England, but its appearance is an event of some importance in political history. The rest of the ideas in Vane's pamphlet are those commonly held by the leading patriots of his time; and the clumsy and intricate style in which they are expressed makes the work any thing but agreeable reading. The earliest written constitution, according to Mr. Mead, the editor of these "leaflets," is that adopted by the people of Connecticut in 1638; and this constitution, with the one adopted the next year by the colony of New Haven, is here reprinted. The New Haven document is largely ecclesiastical; the Church is dealt with as well as the State, all public officers are to be church members, and in the popular convention itself all questions are settled "by sundry arguments from scripture." The Connecticut constitution is more strictly political, and its historical distinction renders it well worthy of a place in this series of popular studies.

*The Seventh Annual Report of the State Board of Health of New Hampshire.* Manchester, State. 8°.

THIS report of the State Board of Health to the governor and council is evidence that the year ending April 30, 1888, was an unusually active one in the State of New Hampshire so far as concerns the details of sanitary administration. A greater demand was made for the services of the board by town authorities, local boards of health, and those in charge of public institutions. In addition to this, the advice of the board was sought in hundreds of individual cases and in all sections of the State. These facts are certainly very encouraging, and demonstrate that there is a growing interest in this State at least, in the subject of sanitation. During the year the legislature enacted a number of important sanitary measures. One of the most important of these placed scarlet-fever and diphtheria among the dangerous pestilential diseases, and gave the board authority for their suppression. Greater powers were extended to health authorities throughout the State in respect to unsanitary dwellings and polluted water-supplies.

One of the most valuable results of the board's labors is that which has come from a sanitary supervision of the summer resorts of the State. The money left by summer visitors at the various resorts aggregates several hundred thousand dollars annually; it builds homes, schoolhouses, churches, and hotels; it increases the valuation of real estate, and in many ways adds to the material prosperity of the towns, villages, and cities. The board recognizes that this great interest should be carefully guarded against the only thing that can ruin it, — disease from neglected sanitation. In the furtherance of this policy, a sewer was constructed at Rye Beach. It conveys the sewage of ten or more of the largest hotels and boarding-houses to the ocean; it is two thousand feet in length, and ten inches in diameter. Its cost was three thousand dollars.

The public water-supply throughout the State has received careful attention. Several towns have constructed water-works, and in every such instance the health of the community has been notably improved. The improvement has been especially marked in the reduction of typhoid-fever.

In the report of 1887 the board gave, in a general way, a statement of the sanitary condition of nearly thirteen hundred school-houses in the State. The surveys of these schools revealed the fact that there was no system used in their construction, and that in a great majority the plans on which they were built were such as might be devised by a carpenter ignorant of architecture and

the requirements of scholars and teachers. These buildings are not ventilated, they are inadequately heated, badly lighted, furnished with a questionable water-supply, and surrounded by foul privies. The present report deals more in detail with these defects, particular attention being given to the schools of Portsmouth and Concord.

The health laws of the State being scattered through the session laws and passed by the various legislatures, great difficulty is experienced by local sanitary officials in determining just what the law is, in reference to any given subject. To obviate this, the board has made a compilation of all such laws, and has published them as an appendix to the present report. The index to the report is very complete. Taken as a whole, this report is a valuable contribution to sanitary literature, and furnishes additional argument for those who maintain that State boards of health should exist throughout the Union, so constituted as to be as permanent as possible, and independent of politics.

#### AMONG THE PUBLISHERS.

THE Open Court Publishing Company of Chicago announces the appearance within the present month of an important contribution to experimental psychology by the eminent French scientist, Alfred Binet. The work is entitled "The Psychic Life of Micro-Organisms," and is published with the sanction of the author, who has written a preface especially for the American edition. The essays forming the work appeared originally in the *Revue Philosophique* of Paris, and were afterwards published in part in *The Open Court*. The original cuts have been procured, and new plates and subsequent additions to the text have been incorporated in the work. The monograph of M. Binet is a presentation of the most important results of recent investigations into the world of proto-organisms. M. Binet has added much to the psychology of the microscopic world by these researches. He has opposed many theories, confirmed others, and advanced many conclusions founded upon his personal investigation. The subject is a branch of comparative psychology little known, and, as a rule, imperfectly understood. Psychologists, and all who are interested in questions of biology, will accordingly look forward to the work of M. Binet as a welcome light on the problem of life.

—Houghton, Mifflin, & Co. will publish, about March 1, an important economic work, "Profit-Sharing between Employer and Employee: A Study in the Evolution of the Wages System," by Nicholas P. Gilman (editor of the *Literary World*). It is the first comprehensive work on industrial partnerships in our language. Written in a popular style, Mr. Gilman's work is commended as "valuable from both the scientific and the practical points of view" by President F. A. Walker, Carroll D. Wright, R. T. Ely, and other high authorities. It will undoubtedly awaken wide interest as an instructive and candid discussion of one promising method for the solution of "labor difficulties."

—The February *Magazine of American History* again anticipates the popular desire, and comes, in honor of Washington's birthday, as a "Washington number." Those who are searching for data concerning Washington's presidential career in New York City will welcome Mrs. Lamb's leading article, "Washington as President, 1789-90," a companion piece to her "Inauguration of Washington in 1789," published in December. The frontispiece represents in a group, Washington, his wife and her two grandchildren, at the age and as they appeared in 1789. The copy of Huntington's great painting of "Lady Washington's Reception" fills two full pages, and the key another page. The house New York was building for President Washington also occupies a full page. The sensational feature of the issue, however, is the De Vries portrait of Washington, discovered in Holland the past summer by the Holland Society of New York, while on its pilgrimage there. Rev. Dr. J. Howard Suydam describes the find, and gives also a picture of De Vries, the owner of the portrait. The third article, by Gen. John Cochrane, presents an unpublished letter of Washington in facsimile, written to Hon. James Duane in 1780. The four articles that follow relate to other themes, — "A Canadian-American Liaison," by Watson Griffin of Montreal; "An Oriental Account of the



Discovery of America," by Alfred J. Hill of St. Paul; "The Mound-Builders and North American Indians, whence came They?" by Jacob Harris Patton, Ph.D.; and "Slavery in New York and Massachusetts," by John Carrick of Chatham, Ont. These are followed by several shorter papers on Washington, and curious and interesting Washingtonia in the various departments.

— Mr. Andrew Lang has followed his "Letters to Dead Authors" by letters about living authors, most of them contributed to the *Independent* during the past year or two. In one of these Mr. Lang pays higher praise to Longfellow than the American Poet has yet received from any English critic. These "Letters on Literature" will be issued here shortly by Longmans, Green, & Co. Under the title of "Colloquies on Preaching," the same firm are about to publish a little book by the Rev. H. Twells on the deficiencies of the modern pulpit. The form of this discussion is quite as unconventional as its suggestions. There are about a score of pertinent dialogues in the little volume.

— *The Voice*—not the *Prohibition* organ—has changed its name to *Werner's Voice Magazine*. It is a monthly devoted to the human voice in all of its phases for speech and for song. Edgar S. Werner, 28 West 23d Street, New York, is the owner and editor.

— Messrs. Frederick Warne & Co. announce that the next volume in their Cavendish Library will be "Leigh Hunt as Poet and Essayist," being the choicest passages from his works, selected and edited with a biographical introduction by Charles Kent.

— John Wiley & Sons, New York, announce as in preparation "A Manual of the Steam-Engine," a companion volume to the "Manual of Steam-Boilers," by Professor Robert H. Thurston; "Steam-Engine Design," for the use of mechanical engineers, students, and draughtsmen, by Professor J. M. Witham; "A Laboratory Guide in Chemical Analysis," second edition, entirely rewritten and revised by Professor David O'Brine of Colorado State Agricultural College; "A Technical Dictionary," defining as an authority all the terms of art and industry, by Park Benjamin; "The Guide to Piece Dyeing," containing 100 samples of the author's own coloring, each sample accompanied with a recipe, by F. W. Reisig, practical dyer and chemist; "A Treatise on Linear Differential Equations," by Professor Craig of Johns Hopkins University; "A Treatise on Masonry Construction,"—containing materials and method of testing strength, etc.; combinations of materials, composition, etc.; foundations, testing the bearing power of soils, etc.; masonry structure, stability against sliding, overturning, crushing, etc.,—complete in one volume of about 500 pages, with 125 illustrations and eight or ten folding plates, by Ira O. Baker, C.E.; "An Elementary Text-Book of Chemistry," by William G. Mixer, professor of chemistry, Sheffield Scientific School, Yale College, New Haven; "Notes in Thermo-Dynamics and Steam-Engine Experiments," by Professor C. H. Peabody, Massachusetts Institute of Technology; "A Treatise on Hydraulics," designed as a text-book for technical schools, and for the use of engineers, by Professor Mansfield Merriman; "Brackett's Elementary Treatise on Physics," abridged from Anthony and Brackett's "Text-Book of Physics;" "Differential Equations," a mathematical treatise, specially prepared with reference to a post-graduate course, by Professor W. W. Johnson; "Kinematics; or, Practical Mechanism," Part II.,—a treatise on the transmission and modification of motion and the construction of mechanical movements, for the use of draughtsmen, machinists, and students of mechanical engineering, in which the laws governing the motions and various parts of mechanics, as affected by their forms and modes of connection, are reduced by simple geometrical reasoning and their application is illustrated by accurately constructed diagrams of the different mechanical combinations discussed,—by Professor Charles W. MacCord, Stevens Institute of Technology; "Preparation of Organic Compounds," introduction to the preparation of organic compounds, by Dr. S. Levy of the University of Geneva, translated and revised by Professor P. T. Austen, Rutgers College, and New Jersey State Scientific School; "Flow of Water in Rivers and other Channels," by Ganguillet and Kutter, translated, revised, and extended by Rudolph Hering and J. C. Trautwine, jun.; and "A Grammar of the

Hebrew Language," greatly enlarged, and for the most part rewritten, by Professor W. H. Green, D.D., Princeton Theological Seminary.

— In the *St. Nicholas* for February, Noah Brooks's account of "The White Pacha" tells the narrative of Stanley's past achievements and probable whereabouts. The paper is illustrated by a striking portrait of the great explorer, and will give many of the older readers of the magazine their first clear idea of the state of affairs in Central Africa. A well-illustrated article upon Japan follows, and is contributed by Arthur L. Shumway; and this, with Mr. Alton's explanation of "The Routine of the Republic," makes up the list of the more instructive articles of the number.

— In *Outing* for February we note the following principal articles: "Sleighing," by Will. H. Whyte; and the second of the series of papers on "American College Athletics—Yale University," by Richard M. Hurd. This article is richly illustrated, as is the description of "A Russian Wolf-Hunt," by Tom Bolton. In addition, we note Charles Lee Meyers's account of the Jersey City Athletic Club; an entertaining description of "A Trip across Wyoming on Horseback," by L. P. Robie, illustrated by E. W. Deming; and "Herne, the Hunter," a tale of mountain life, by W. Perry Brown. The "Editorial Departments" are attractive, while the "Records" present the latest achievements of athletes in the different sports and pastimes.

— Assistant Superintendent N. A. Calkins of New York City, so well known by his books on "Object-Teaching," has in press a little volume for teachers on "Ear and Voice Culture," to be published by E. L. Kellogg & Co. of New York and Chicago.

— "Easy Experiments in Science," is the title of a little handbook by Professor J. F. Woodhull, formerly of the normal school at New Paltz, N.Y., to be published in February by E. L. Kellogg & Co., New York and Chicago.

— There is a timeliness in several of the articles in the February *Atlantic*. "The New Talking-Machines" is the subject of an article on the phonograph by Philip G. Hubert, jun. Charles Worcester Clark discusses "The Spirit of American Politics as shown in the Late Elections." A feature of this number is the address to the assembly at the opening of the new Players' Club in New York, by T. W. Parsons, which became the special property of *The Atlantic*, and which is now for the first time published. In sharp contrast with this witty and cheerful poem, Henry C. Lea writes on "Brianda de Bardaxi," describing one of the fiendish devices of torture devised during the time of the Inquisition; Agnes Repplier, one of the brightest essay-writers in America, contributes "A Plea for Humor;" Harriet Waters Preston, in an article entitled, "Under which King," paints in glowing colors certain passages in the life of Cicero; and Samuel H. Scudder finds a congenial topic in "Butterflies in Disguise." The prominent reviews are on the "Letters of Felix Mendelssohn," "Ancient Rome in the Light of Recent Discoveries" (the Lanciani book), and "Illinois Life in Fiction." Some rather quaint points are raised in "The Contributors' Club;" and "Books of the Month" is, as usual, readable and entertaining.

— It is worthy of note that editions of every important book published here by Charles Scribner's Sons in the past season have been printed in England.

— The Travellers' Insurance Company will publish at once, in five octavo volumes, a uniform edition of the works of Walter Bagehot, the economist.

— Macmillan & Co. will shortly publish an American novel on the subject of divorce, entitled "Faithful and Unfaithful," by Miss Margaret Lee.

— The Forest and Stream Publishing Company announces "Sam Lovel's Camps," a sequel to "Uncle Lisha's Shop," by Rolwand E. Robinson. It is descriptive of Vermont life and character forty years ago.

— C. Wellman Parks, of the Rensselaer Polytechnic Institute, Troy, N.Y., has undertaken the preparation of an exhibit of American periodicals for the Paris Exposition of 1889, and requests all interested to help him make it complete and worthy.

## LETTERS TO THE EDITOR.

## Indian Relics from North Carolina.

DURING the past summer the writer was one of a party who tramped through the mountains of western North Carolina for a month. The country was extremely rough, and we were somewhat surprised at the exceeding abundance of Indian relics. Arrow-heads were found almost everywhere, and we often picked them up even in the roads. There was hardly a mountaineer to be found who had not at least a hatchet or a scraper, and often a native would come in smoking a pipe he had found in his cornfield. The favorite material for the pipes and scrapers was soapstone. Some of the former resembled in shape the common clay-pipe bowl;

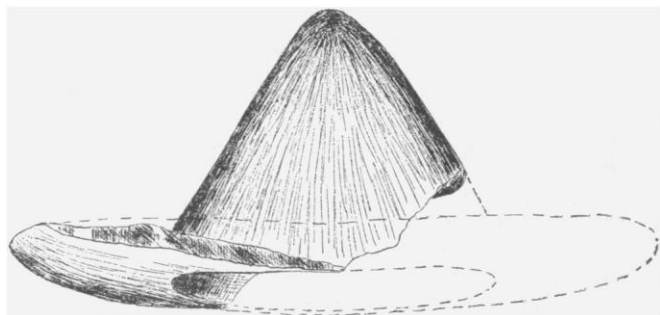


FIG. 1.

and it is possible that such are recent, for it is not more than forty or fifty years since the Cherokees roamed over all that region. Still we saw none such among the Indians on the Reservation, and of many of the relics they know as little as we. The hatchets were of a variety of materials, and none of them highly polished.

In almost every cornfield the soil was filled with fragments of pottery, some solid and showing marks of fire, others crumbling to dust. One could pick up pieces by the thousand, and not one could be found which did not show some form of ornamentation. All the designs were geometrical figures formed by combinations of straight lines and curves, both circular and spiral. The edges of the vessels seemed in some to be plain, and in others raised and scalloped or notched. None were found showing any traces of

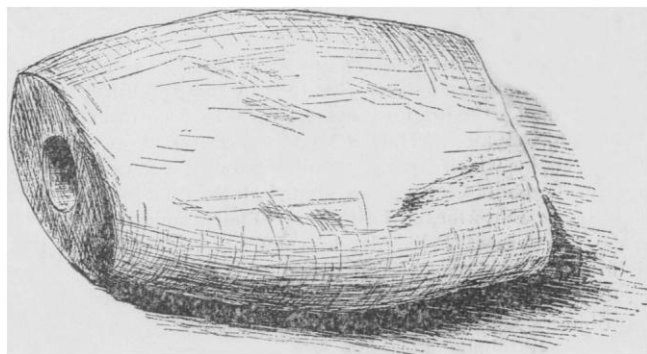


FIG. 2.

handles, or any lines of chafing from cords. The designs were evidently made with a sharp point while the clay was soft. The Cherokees still make much of their own pottery, but it is rude, and as a rule unornamented.

We ran across several specimens which puzzled us. One, which is represented in Fig. 1, was shown to us by the owner of a gold-mine near Cashiers Valley, Jackson County. It was washed out in the gravel. We were permitted to make a drawing of it. It is neatly cut from a greenish soapstone, and is quite smooth. It is badly broken, but the apparent form is indicated by the dotted line. It resembles somewhat one of the old-fashioned sugar-loaf hats, and is neatly hollowed out on the inside. Nearly in the middle of the side, as will be seen from the drawing, is a small hole drilled through the stone. We could think of no possible use for such an implement.

Another interesting one, found in a field near the Nautehala Mountains, in Macon County, is shown in Fig. 2. It is an oval block of soapstone, with perfectly flat ends, and has in one end a

neatly cut circular hole 1.5 centimetres in diameter, and 2.3 centimetres deep. The length of the specimen is 9.7 centimetres, and its greatest breadth 8.5 centimetres. The surface is comparatively smooth, but no attempt seems to have been made to polish it. It is now in the possession of the writer, who would be glad to receive any information as to its use.

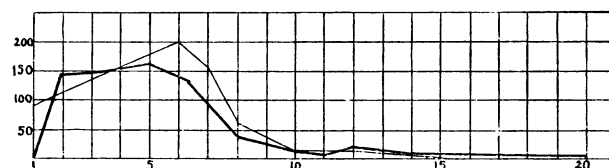
The only mound we saw is close to the town of Franklin, the county seat of Macon County. This stands on the bottom-lands, not far from the Tennessee, and is well preserved. It is an oval truncated cone; and we estimated the greatest diameter of the base at seventy-five feet, and its height at twenty feet. We heard of another on the road from Charleston to the Indian Reservation at Yellow Hill, but failed to find it. Beads, arrow-points, pottery, and other relics, are often ploughed up near these mounds, but the limited time at our disposal prevented any very thorough exploration.

L. N. JOHNSON.

Evanston, Ill., Jan. 19.

## The Characteristic Curves of Composition.

I WAS intensely interested in the article *Science* published more than a year ago, by Professor Mendenhall, on style curves, and made up my mind to submit the Bacon-Shakspeare question to a style-curve test at once. But somehow it was only last week that I



got at it. I enclose you the result. The light line is Bacon; the heavy, Shakspeare.

In order to understate it, if possible, I selected the Shakspeare from Oliver's speech (*Twelfth Night*, II. i. 110), — a passage almost as sententious as Bacon's acknowledged work; and the Bacon from his "Essay on Youth and Age." APPLETON MORGAN.

New York, Jan. 19.

## The Permian Rocks of Texas.

AS it is evident that the question of the occurrence of Permian strata in America will again be raised at an early day, and that generalizations will be based upon the as yet little studied Texas region, it may be in order to state that we have here a great series of beds, beginning west of the 97th meridian, and succeeding the carboniferous; and beneath the undoubted Wealdan beds of the cretaceous, a great development of strata, the lower half of which cannot possibly be referred to any other age than the Permian, although the upper portion is probably triassic. Professor Cope has long since described the vertebrates of these Permian beds; and the *Mollusca*, I am informed, are now being examined. The stratigraphy, however, has as yet only been reconnoitred, and no section whatever determined. The writer, however, made two journeys across the region into New Mexico last summer, to observe the problem, and was impressed with a fact which should be borne in mind in future discussions of the region. The stratigraphic features agree, as far as could be seen, in nearly every generality with those of the Kanab Valley of Utah as described by Mr. C. D. Walcott, a few years ago, in the *American Journal of Science*, and were the direct eastward continuation of the same. Not only does this similarity agree with the Permian beds, but with the upper beds, which he calls triassic. This connects the Grand Canon and Texas Permian-triassic basin beyond all doubt; and to Mr. Walcott belongs the credit of the first and only intelligible section of the American Permian, a most marked and unmistakable terrain, the discovery of which was made, as agreed, by Professor Jules Marcou. This fact, together with the distinct basin type of structure of the trans-Pecos region, to which I have recently called attention, and the determination of many distinctly western geographic features extending two-thirds the way across Texas, makes this State pre-dominantly western, although its eastern third is within the limit of the timber-covered southern coastal plain.

ROBT. T. HILL.

Austin, Tex., Jan. 21.